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Current Practices in the Teaching of Science in the Seventh and Eighth Grades*

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GENERAL SCIENCE is offered in the seventh and eighth grades in an increasing number of grammar schools in the United States; it has already become established in many junior high schools. For a longer period of time it has been a part of the curriculum of the ninth grade. Statistics of the Bureau of Education for 1921-1922 show that 14.84 per cent of all the pupils enrolled in public high schools in cities with a population of 100,000 or over are taking general science. This represents the largest number taking any one science in high school.[1]

Efforts of the reorganization movement in science have been directed chiefly towards the work of the ninth grade. In isolated cases in progressive schools attention has been centered on general science in the seventh and eighth grades. Programs of organization showing the earlier tendencies in this field have been published.[2]

The more recent trend of development in junior high school has been defined by one author in terms of civic and community problems.[3]

This study has been made to determine the consensus of opin-

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* This study was made in connection with graduate work at Teachers College, Columbia University.

1 General Science Quarterly, 8:348.

2 Carpenter, Harry A., General Science in the Junior High School at Rochester. General Science Quarterly, 1:214-222. Lyman, L. R., The Ben Blewett Junior High School of St. Louis—Part 11. School Review, 28:99-101, 107, 110, 111. Waterhouse, R. H., General Science in the Amherst Junior High School. General Science Quarterly, 2:331-336.

3 Whitman, W. G., Civic Science: General Science for the Junior High School. General Science Quarterly, 5:76-88.

ion among teachers of the seventh and eighth grades as to what material should be offered, and the method of presentation. The seventh and eighth grades were considered collectively; no effort was made to distinguish between the exercises suitable for one grade or the other.

A questionnaire, consisting of two parts, was sent out in January, 1924. Part I contained a list of seventy-five exercises. These were chosen after a careful examination of text books and manuals of general science. An effort was made to include representative exercises from each unit of subject matter that commonly occurs in a thorough course in science in the ninth grade. It was not intended that the list should include every exercise which might be carried out under each unit of study.

Two types of exercises may be found in this list: the "pure science" type of problem, organized around the principles of some particular branch of science, and the practical or applied science type, exercises related to experiences common in the everyday life of the individual. Thirty-seven exercises are of the "pure science" type; thirty-eight of the applied type. The exercises starred represent the latter type.

A brief comparison of exercises of each type will illustrate the distinction:

Exercise 67. Determine the composition of water.

Exercise 2. Learn what is done to keep drinking water pure.

Exercise 67 is of the "pure science" type; when the laboratory determination of the composition of water has been made, it has no practical bearing on the life of an individual.

Exercise 2 contains a problem that touches upon the life of every individual. How to keep drinking water pure is one of the crucial problems of existence. It involves scientific principles of both physical and biological nature, but these are embedded in a utilitarian, human problem.

Part II dealt with the method to be used in performing these exercises. There are three laboratory methods commonly used: demonstration (by teacher or pupil), individual, and group methods.

Some recent experimental studies have attempted an evaluation of the different methods of laboratory procedure. Re-

sults by Kiebler and Woody[4] in physics, and Cooprider[5] in biology, indicate that there is very little difference in the amount of learning between the individual and the demonstration methods. Kiebler and Woody find that certain exercises are best performed by the individual method, others by the demonstration method; they suggest the need for a scientific classification of experiments according to the method to be used in their presentation.

Investigations such as these have opened up the field of laboratory method in science. The present study attempts to determine merely the opinions and practice of grade teachers respecting this point.

One hundred and fifty questionnaires were sent out to teachers of general science in the seventh and eighth grades of public schools throughout the United States. A total of sixty-six replies were received. Five stated that general science was not included in the curriculum of their seventh and eighth grades; six could not be used because they were sent in by those not actually teaching seventh and eighth grade science; two arrived too late to be included in the results. The total of fifty-three replies used in tabulating the results is assumed to represent a fair sampling of the opinions of teachers in this field.

The author wishes to acknowledge her indebtedness to all those we contributed to this study.

Replies were received from public schools in twenty-nine different states and the District of Columbia.

The following directions were given with the list of seventy-five exercises:

I. (a) Check (√) approximately one-third of the exercises in the following list which you consider most valuable for pupils in the seventh and eighth grades.

(b) Check (x) those exercises which you consider least valuable for pupils in the seventh and eighth grades.

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4 Kiebler, E. W. and Woody, Clifford, The Individual versus the Demonstration Method of Teaching Physics. Journal of Educational Research, 7:50-58.

5 Cooprider, J. L., Laboratory Methods in High School Science. School Science and Mathematics, 23:526-530.

II. (a) Experimental work in the laboratory may be performed by the demonstration method, by individual students, or by groups of students working together. Please write beside each exercise checked the letter D, I or G, to indicate which method you use.

(b) If all facilities were at hand for laboratory work, would you vary your method?

III. Comments.

As printed in this article, the list of exercises has been rearranged according to the results of the questionnaire, those at the beginning of the list representing the exercises considered most valuable by the greater number of teachers, those at the end the least valuable. Exercises of the practical science type are starred; they were not differentiated from those of the pure science type on the original questionnaire.

*1. Learn how to use a fire extinguisher.
*2. Learn what is done to keep drinking water pure.
*3. Learn how house-flies may carry disease germs.
*4. Learn how typhoid fever is transmitted.
*5. Learn how disease germs may get into milk.
*6. Learn why boilers and pipes in basements are covered with asbestos.
*7. Learn how to recognize a few constellations.
*8. Learn how a fuse may be replaced when it has burned out.
*9. Learn what kinds of food give energy to the body.
*10. Learn how to read the electric meter.
*11. Learn how to stop a leak in a water faucet.
*12. Learn how to take care of milk in the home.
*13. Find out how cotton goods may be distinguished from wool.
*14. Learn how short circuits are formed.
15. Determine the effect of evaporating liquids upon the temperature of bodies.
16. Learn how to purify water by distillation.
*17. Learn how the electric bell operates.
*18. Learn how to protect clothing from moths.
*19. Learn how insects that injure plants may be destroyed.
*20. Make a list of fires reported in the daily newspapers, and tell whether they were avoidable or unavoidable.
*21. Learn where anthracite and bituminous coal are mined, and learn why one is more expensive than the other.
*22. Learn how a fireless cooker is used.
*23. Learn what is done with garbage in your community and the expense of having it removed.
*24. Learn how coke and charcoal are made, and the use of each.
*25. Learn the organization of your health department and its duties.
26. Determine whether cold air is heavier than warm air.
*27. Learn in what way use is made of the law that water seeks its level.
28. Determine the effect of heat on water.

29. Demonstrate how carbon dioxide is made.
*30. Study traffic rules.
*31. Find out how soils are formed.
32. Determine whether air occupies space.
*33. Find out what ten different kinds of birds eat.
34. Show how a lever is used in doing work.
35. Demonstrate how milk is pasteurized.
36. Determine by experiment the products formed by a flame.
37. Demonstrate that green plants give off oxygen.
*38. Learn how to get rid of roaches in the home.
39. Prove by experiment the presence of water vapor in the air.
40. Show how a lift-pump works.
41. Determine what makes some water "hard."
42. By experiment prove that water seeks its level.
*43. Learn why "quarter in the slot" gas meters may be dangerous.
*44. Make soap.
45. Prove that water and carbon dioxide produced in the human body.
46. Determine how a magnet acts towards different substances.
*47. Make a pin-hole camera.
48. Determine whether substances take fire at the same temperature.
*49. Learn how starch is made by plants.
50. Determine the temperature of boiling water.
51. Determine the ability of soils to hold water.
*52. Learn why radiators can be made hot quicker with steam than with hot water.
53. Test for carbohydrates, fats and proteins in food.
*54. Learn the effect of air currents on evaporation.
*55. Make a list of the different things sold in the local market for the destruction of house-flies.
56. Prove that growing yeast plants produce carbon dioxide.
57. Show how water carries heat.
58. Determine whether moisture is given off by growing plants.
59. Find out the mechanical advantage and the efficiency of a pulley system.
60. Prove that sound travels in waves.
*61. Learn how gases pass into and out of the leaves of a plant.
*62. Make a grapical comparison of the Fahrenheit and Centigrade thermometer scales.
63. Freeze some ice cream and study the principles involved.
64. Demonstrate how starch is digested.
65. Measure the amount of work done in climbing stairs.
66. Prepare hydrogen and learn its properties by experiment.
67. Determine the composition of water.
68. Determine whether light travels in a straight line.
69. Determine by experiment that the loss of weight by an object immersed in water is equal to the weight of the water displaced.
70. Determine whether liquids diffuse.
71. Show how dust explodes, using lycopodium powder.
72. Determine the relation between the amount of light and the distance from the source.
73. Determine that gases mix with one another.
*74. Calculate the possibility of overproduction of plants and animals.
75. Show by experiment how the candlepower of lamps is determined.

TABLE I. TABULATION OF RESULTS ACCORDING TO RANK ORDER.

Reading: Exercise 1 was checked as valuable by 49 teachers; it was not checked by 4 teachers; it was checked as least valuable by none.

Exercise	Number checking exercise as valuable	Number not checking exercise	Number checking exercise as least valuable	Exercise	Number checking exercise as valuable	Number not checking exercise	Number checking exercise as least valuable
1	49	4	0	39	19	26	8
2	49	4	0	40	19	23	11
3	44	6	3	41	18	31	4
4	43	8	2	42	18	27	8
5	43	9	1	43	18	27	8
6	39	11	3	44	18	22	13
7	39	11	3	45	18	22	13
8	39	10	4	46	17	25	11
9	37	14	2	47	17	25	11
10	37	11	5	48	17	23	13
11	36	13	4	49	17	20	16
12	35	15	3	50	16	33	4
13	34	15	4	51	16	30	7
14	33	18	2	52	16	28	9
15	33	11	9	53	16	21	16
16	32	19	2	54	15	29	9
17	32	18	3	55	15	26	12
18	31	18	4	56	15	25	13
19	31	17	5	57	13	30	10
20	30	17	6	58	13	27	13
21	30	15	8	59	13	21	19
22	29	17	7	60	13	18	22
23	28	21	4	61	12	24	17
24	28	20	5	62	12	19	22
25	28	19	6	63	11	28	14
26	27	22	4	64	10	30	13
27	27	15	11	65	10	19	24
28	26	23	4	66	10	14	29
29	26	17	10	67	9	19	25
30	26	17	10	68	9	17	27
31	25	25	3	69	8	19	26
32	25	17	11	70	5	23	25
33	24	25	4	71	5	16	32
34	23	22	8	72	5	16	32
35	23	22	8	73	4	21	28
36	20	22	11	74	3	22	28
37	20	21	12	75	1	13	39
38	19	27	7				

PART I.

Table I shows the tabulation of results according to rank order. Of the twenty-five exercises ranking as most valuable, all but two, exercises 15 and 16, are of practical or applied science type. Of the eleven at the end of the list, those considered least valuable, ten are of the pure science type. This indicates conclusively that opinion favors the practical, more humanized type of science in the seventh and eighth grades.

The consensus of opinion among teachers actually engaged in work of the seventh and eighth grades, as shown by this investigation, indicates that the science material for these grades should be organized around problems of everyday life.

Of the twenty-five exercises ranking highest on the list, fifty-six per cent are of a physical nature, forty-four per cent of a biological nature. This indicates a tendency to disregard the ordinary boundary lines of the science subjects in the seventh and eighth grades.

PART II.

There is great variation shown in the method used by teachers in presenting exercises. This suggests that the method depends to a large extent upon the nature of the problem.

Of the fifty-three reports used in this study, forty-two considered the problem of method. The largest number of teachers marking any one exercise was thirty-five. Eight teachers would use the demonstration method solely. Nineteen would use the demonstration method in sixty per cent or more of the exercises checked; eight would use the individual method for fifty per cent or more of the exercises; two would use the group method for fifty per cent or more of the exercises. These results show a preference for the demonstration method. Comments, indicate, however, that practice is governed in many cases by circumstances rather than by needs of the children.

An Herbarium of City Trees

EMMA L. KEMP, Lincoln High School, Jersey City, N. J.

SEVERAL years ago an Arbor Day speaker at our school told the pupils that it is better to plant Norway maples than Carolina poplars, in the city. I found that very few of my pupils

knew these trees. So since then I have devoted most of the time allotted to plants in general science to the study of trees, with a view to the recognition of the common trees of the city. This work is not likely to be repeated in the higher grades, as I find there is little time for a detailed study of trees in the course in general biology which some of my pupils will take next year.

I have used various methods, but this term feel that I have found one very much more satisfactory than anything used in the past. A pupil brings in a twig bearing several leaves, and puts it in water. He writes the date, his name, and that of the street where the specimen grew, on a card. The teacher adds the common and scientific names of the tree. When they come into class, the pupils examine the specimen on the table and record its common and scientific name in their notebooks. The specimen is then placed in a press, consisting of folded newspapers between two boards. We hope some day to have a large cement block for a weight, but at present a large stone jar filled with specimens from our rock collection does very well. When dry, the specimen is mounted on a sheet of white bristol board, eleven and three-eighths by sixteen and one-half inches, by means of small strips of white adhesive cloth tape. A label bearing the names of the tree, the number, date, locality where collected, and the name of the collector, is attached in the lower right corner The mounted specimens are hung on a wire extending along the side of the room and the pupils are allowed time to study them each day. On the twelfth day of this collecting we mounted our thirty-first specimen and there is still time to add more before the leaves fall. It is difficult to get good specimens of some of the trees, but we use the best that are brought in. We have a fairly presentable herbarium of the trees of our city, to which the next class can add in the spring.

To look up the names of specimens the following are found useful: Gray's "New Manual of Botany" and "Field, Forest and Garden Botany"; "A Manual of Cultivated Plants," by L. H. Bailey; "Our Native Trees," Keeler, and "Tree Book," by Rogers. The pupils are enthusiastic collectors and now report with regret that they can find nothing new to bring in, but they will find others. The scientific names were rather

hard at first, but as additional species in a genus are brought in they are ready to tell the genus when I give them the common name. They saw the value of these names when they confused the sycamore with the Norway maple, and I pointed out the similarity in the genus, Platanus, of the former, and the species, platanoides, of the latter. Being able to recognize and name the common trees of the city, they see trees as they never did before and realize their value in beautifying the city. Being acquainted with trees in this way, they are more interested in knowing why the Norway maple and, to a great extent now, the sycamore are being planted instead of the Carolina poplar, and facts about proper planting and care mean more to them.

The Position of General Science in the Secondary School of Today

George W. Hunter, Knox College, Galesburg, Ill.

We live in an age of science and the last decade has witnessed an extraordinary development in matters scientific. We may well ask if the public high school is doing its share in interpreting to its student body the everyday science phenomena of the environment of its pupils. With this question in mind the writer, a few months ago put out a questionnaire, which was sent to one thousand high schools in various parts of the United States. These schools were representative, largely taken from cities of 10,000 and more, although a few were township or county high schools. The basis of the list was made up from a similar list used by the writer in 1908, in preparation of an article which appeared in *School Science and Mathematics,* Vol. 10, 1910. The title of the article was, "The Method, Content and Purpose of Biological Science in Secondary Schools of the United States."

The present questionnaire followed largely the first questionnaire, but two or three additional questions were included which were intended to bring out the relationships of the new elementary science which has come into the high school horizon practically since 1908. At that date some 276 schools answered the questionnaire and showed the following distribution of

science in the first year of the high school: 76 courses in Botany, 36 in Biology, 105 in Human Physiology and Hygiene; 9 courses in Introductory Science; 94 in Physiography; 27 in Zoology, and 13 scattering courses. The present questionnaire, with reports from 368 schools, gives in the first year, 244 courses in General Science, 73 in Biology, 19 in Botany, 7 in Zoology, 61 in Human Physiology, 44 in Physiography, and 4 scattering. In addition to this 68 junior high schools report courses in general science in the seventh and eighth grades. Put in another way, in 1908, 276 schools reported 9 courses in General Science, 166 in Physiography, 623 Biological courses of which 73 were Biology and 193 Human Physiology, 253 in Chemistry, 268 in Physics, and 44 scattering. In 1923 368 four-year high schools show 252 General Science courses, 138 Physiographic, 672 Biological, of which 311 were Biology and 165 in Human Physiology; 415 Chemistry, 423 Physics, and only 12 scattering courses. In addition to this were the 68 courses in General Science mentioned above.

Reducing these figures to a percentage basis, an interesting comparison is afforded. In 1908 the General Science courses amounted to .7% of the total of science courses offered in the four-year high school; Physiography had 12%; Botany, 16.5%; Zoology, 11%; Human Physiology, 14%; Biology, 5.3%; Chemistry, 19.2%; Physics, 19.6%; and scattering courses had 3.3%. In 1923 the percentage of General Science courses in four-year high schools was 13.13%; in Physiography it was 7.20%; in Botany, 6.41%; in Zoology, 3.8%; in Human Physiology, 8.60%; in Biology, 16.21%; in Chemistry, 21.63%; in Physics, 22.21%; and there were .06% scattering courses.

For those of us interested in the growth of General Science the above figures are most interesting. I well remember that in 1908 "Introductory Science," as it was then called, had its firmest hold in Massachusetts, where three schools offered courses and where the Springfield experiment was then being watched with much interest. One course in Introductory Science came from Connecticut, one from New York, one from Pennsylvania, one from Ohio, one from Illinois, and one from Nebraska. Out of this small beginning, in a brief span of fifteen years,

courses in General Science have multiplied and now occupy a very material part of the time devoted to science in the first year of the high school. As a matter of fact, over 54% of all science courses in the first year of the four-year high schools reporting are now General Science. New York State alone stands out a laggard in the teaching of General Science in the ninth grade, and here the situation is a purely artitrary one brought about by the state system of education, which imposes regent's examinations in Biology the first year of the public high school.

If time were available much might be said concerning the sequence of science as it is now working out in the public hgh school. Whereas fifteen years ago there was little or no sequence, there appears now to be a very definite one. General Science has already monopolized the greater part of science teaching in the ninth grade. General Biology is rapidly replacing courses in Botany and Zoology in the tenth grade. The Physical and Chemical Sciences are about equally divided between the eleventh and twelfth grades.

What does all this mean? Can we interpret these figures? A further analysis of the questionnaire shows distinctly that we can. In schools where General Science is being given there appears to be a real belief on the part of the teachers that this work, when properly correlated with the subsequent work of Biology, Chemistry and Physics, gives the pupil a preliminary introduction to science that not only enables him to choose his subsequent courses intelligently, but gives the science teachers a foundation on which to build. There seems no doubt that we are treading along a definite path and that the way is already well marked. The next problem that faces us as science teachers will undoubtedly be the question as to how far into the grades this general science background shall extend, and to what extent this will modify our present concept of teaching in the junior high school and elementary school.

How Our Good Friend Heat Travels

O. E. Underhill, High School, Amesbury, Mass.

The children are in the schoolroom, waiting for the teacher to arrive. Alice is near the window, through which the sun is streaming. She is busily engaged in placing the palm of her hand first on the window-pane and then on the sill, her attention having been attracted by the difference in temperature.

Alice.—I wonder why the glass feels colder than the wood?

Charles.—Ask teacher when he comes; he'll tell us.

Teacher enters. Alice runs up to him.

Alice.—Oh, sir, please tell us why the glass in the window feels colder than the wood.

T.—Because it *is* colder.

Alice.—Oh!!

Charles.—But why *is* it colder? The wood and the glass are right together in the room, and are both getting the same amount of sunshine.

T.—Before I can answer your question so that you will understand, I must tell you something about heat. How is your house heated, Mary?

Mary.—There is a furnace down cellar in our house.

T.—How does a furnace down cellar heat your house upstairs?

Mary.—The heat goes through pipes.

T.—What goes through pipes?

Mary.—Heat.

T.—Just heat? Nothing but heat?

Mary.—You can't see anything else.

T.—What does the heat look like?

Mary.—Oh, you can't see that, either. The pipe is empty except for the heat.

T.—Isn't there anything else in the pipes?

Dora.—There must be air in them.

T.—Yes, indeed, Dora, and if there were no air in the pipes the heat would not be able to come from the furnace to your rooms. Do any of you live in a house which is heated in a different way than Mary's is?

Ernest.—Water runs through the pipes that carry the heat from our furnace.

Dora.—Steam runs from our furnace to the different rooms.

Beatrice.—On cool nights we light a fire in the fireplace to keep us warm.

T.—You have mentioned several ways in which heat is carried. In Mary's house the heat is carried around in pipes filled with air. In Ernest's house, pipes full of water carry the heat around, and in Dora's house pipes filled with steam carry the heat about. When heat is carried along with something else in this way, we say that the heat is transferred by convection. *"Convection"* comes from the same word in Latin that "convey" comes from. The first part of the word comes from a word meaning "together," and the last part from "via," meaning "way." You have perhaps seen it on the street-car signs, "via High Street," or "via Main Street." From this word we get the word "vehicle" or "conveyance," that is "carried together." So convection is the carrying of heat. Perhaps what I have said will help you to remember the word. I will write it on the board. (Teacher prints the word "convection" at the left of the board.) There are two other ways in which heat is transferred from one place to another. I think you ought to learn them, so I wil write them here on the board too, so you may look at them while we talk. Then I will try to show you examples of the different ways. (Prints on board, so that it reads as follows:)

WAYS OF TRANSFERRING HEAT.

1. CONVECTION 2. CONDUCTION 3. RADIATION

Before we go any further, I want to be sure you know what the word "transfer" means. Will you tell us, Charles?

Charles.—It means taking something from one place and putting it somewhere else.

T.—Yes, Charles that is it. Now, when heat is carried along with something else, we say it is transferred by convection. When heat is passed along from one part of a substance to another, instead of being carried, we say the heat has been transferred by conduction. Can any of you think of some way in which heat is transferred by conduction?

Beatrice.—If your cocoa is very hot, the handle of the spoon you stir it with becomes hot.

Fred.—My mother left the stove-lifter in the cover of the stove the other day, and when she took hold of it, it was so hot she burned her hand.

T.—Yes, those are both good examples of the transference of heat by conduction. I will show you how heat is transferred in this manner. Here is an iron rod. (Supports it on stand.) I will fasten little balls of wax along the rod about three inches apart, by warming the wax and sticking it to the rod. (Teacher so does, while talking.) Now I am going to heat one end of the rod. (Puts burner under one end; the balls of wax drop off one after the other, as the rod becomes hot.)

Charles.—The heat passes along the rod.

T.—That is just it, Charles. The layer of iron next to the flame becomes hot. Then it passes the heat on to the next layer of iron, and so on, until the whole rod it hot. It conducts the heat from one end of the rod to the other, so we say the heat is carried by conduction. Now I am going to take three rods, one of wood, one of aluminum, and one of iron, fasten balls of wax the same distance apart on each of them, and arrange them so that one end of each of the rods is in the flame. (Arranges rods as he talks.)

Mary.—The balls of wax on the aluminum rod drop off before the ones on the iron rod fall.

Beatrice.—The end of the wooden rod has caught fire, and the first ball hasn't dropped yet.

T.—Why are some frying-pans made of aluminum now, instead of iron?

Mary.—Because the heat from the stove goes through the aluminum into the food that is being cooked more quickly than it would go through iron.

T.—Yes, Mary, that is one reason.

Charles.—Then they put wooden handles on irons and stove-lifters and kettle-covers and other things, because the heat doesn't go through the wood at all.

T.—Yes, Charles, that is it. Mary, the heat that comes from your furnace comes out at only one place in the room, yet the whole room soon becomes heated, doesn't it?

Mary.—Yes.

T.—How do you suppose the heat gets to the other side of the room?

Mary.—The hot air goes over there.

T.—Yes, the heat is carried by the air. The part of the air that is near the fire in the furnace becomes heated, and comes up through the pipe and the register into the room. Then it moves over to another part of the room, taking the heat with it, while more cold air moves down near the fire in the furnace until it becomes warm. Water acts the same way. I mean, if you heat water at the bottom of a dish it will move away towards the top. Some of the colder water will go to the bottom to be heated, until the whole dishful is hot. The heat is carried by something moving off with it, so it is transferred by convection, and these currents of air or water which carry the heat are called convection currents.

I will try to show you the difference between convection and conduction. All of you stand in line as close together as you can. Now imagine you all together represent a bar of iron. Here is a pile of books which I will place in front of you, Alice. The pile of books represents the heat from a lamp. Remember that heat is not a substance like a book, however. I will try and tell you a little about what heat *is* later. Imagine that you without a book are a cold bit of iron—part of a rod of iron—but if you have a book in your hand you are a hot piece of iron. Now, Alice, when I say "go," pick up a book from the pile and pass it back of you to Mary, who will in turn pass it back to Charles, and so on to the end of the line. Alice, as soon as Mary takes the book, you pick up another one from the pile and pass it back to Mary. Keep this up until everyone has a book. Now, are you ready? Go.

(The pupils pass the books as directed, laughing and hurrying to keep up with Alice, who is passing books back as fast as possible.)

Now, you see each of you has some heat, but it was passed along, not carried. That represents the transference of heat by conduction. Now pass the books back to Alice again.

Now we will represent convection currents. All of you spread out around the room. Go far enough apart so you cannot touch one another. Now, you represent a room full of cold air. John, you are nearest the pile of books; pick up one

and run to the back of the room with it. The rest of you run around the room, and whenever anyone comes near the pile of books, take one and run to the back of the room with it. Keep this up until each of you has a book. Ready! Go!.

(Business of running around.)

Now you are a room full of warm air. The heat was carried around instead of being passed along. Do you see the difference between these two ways of carrying heat about now?

Chorus.—Oh, yes, we see that.

T.—Beatrice, perhaps you have noticed that if you have a good fire of live coals in your fireplace, when you put your face near it seems to feel hotter than the air itself?

Beatrice.—Oh, yes. And if a chair is near, it will become so hot that one can hardly touch it, yet the air in the room near it does not feel so hot.

T.—You are quite observing to notice that, Beatrice. When anything is very hot it gives off waves of heat called "radiant heat." This heat passes through things without warming them very much, but if these heat waves run up against anything they cannot pass through they warm it up. Now the heat from the fireplace passes through the air without warming it very much, but when it hits your face, or the chair, it heats them up much more. The sun gives off radiant heat.

Alice.—Oh, I see. The sun's heat comes through the glass and doesn't heat it much, but when it strikes the wooden window sill, it heats that, so it is warmer than the glass.

T.—Yes, that is about it. Now do you see why greenhouses are made of glass?

Charles.—The sun's heat comes through the glass and warms up the earth and the plants.

T.—Yes. It is like a sun trap, because when the radiant heat has warmed the earth in the greenhouse, the earth doesn't give off these heat waves, so that the heat is trapped in the greenhouse and cannot get out again the way it came in.

John.—Can it get out any other way?

T.—It can get out by convection or conduction. For instance, the air next to the earth would become very warm, and carry the heat through the greenhouse by convection until all the air in the greenhouse was warm. Then the air in contact with the glass would warm the glass, and it would pass the

heat by conduction to the outside. But very little heat is lost in this way, as glass is a very poor conductor of heat. See, I will place a wax ball on this glass rod a few inches from the end. Now I will heat the end of the rod in a flame. See, I can melt the end of the glass rod; it is red-hot, but not enough heat is passed along the rod to make the wax ball drop off.

Charles.—If a fireplace heats by radiation, and radiant heat passes through the air without heating it, how does a fireplace warm a room?

T.—I am glad you asked that question, Charles. Do you remember what we said air was like?

Charles.—You said it was made up of little particles of different gases. These particles are called molecules. They are ever so small, with a lot of space between them, and they move around.

T.—Yes. If waves of radiant heat pass between these molecules of air they are not warmed up. If some waves hit some of the molecules, however, it warms them. Then they travel around to other parts of the room, so that the room is heated partly by convection. I can't tell you just what heat is, but the faster these particles move, the hotter they are. If you make them hot by putting something hot near them, as when I put the flame of the burner near the iron rod, they move faster. They bump the molecules near them and so make other molecules move faster too. They, in their turn, become hot. If you can make the molecules move faster in some other way than by heating them, they will become hot just the same. If you pound a nail with a hammer it will become hot. We may say, and be very nearly correct, that heat is the effect of molecules in very rapid motion. But this is becoming rather hard for you to understand. We had better leave the discussion of what heat is until you are a little older. You can remember that there are three ways of transferring heat,—by convection, by conduction, and by radiation. I am going to give you a sheet of paper now, and I want you to put down in three columns, under the heads of conduction, convection, and radiation, all the different examples of heat transference you can think of, and bring the papers to me tomorrow.

Is 1925 to be a Cold and Dry Year?*

SCIENCE teachers know of the splendid work of the Weather Bureau. We generally look for the weather forecast the first thing, when we take up the morning paper. It is truly a wonderful thing that weather can be predicted as accurately as is done several days in advance. But now it is suggested that we shall soon be able to know the general weather to be expected a year or two in advance. Meteorologists the world over are working on this problem. The British, Norwegian, Danish and Dutch weather bureaus have done some very significant work in studying ocean temperatures.

The United States Navy is planning an expedition to secure more complete data of this character. The most interesting application of ocean studies has been made by Mr. Herbert J. Browne of Washington, D. C. While we must admit that the data which Mr. Browne employs appears fragmentary, the accuracy of his forecast during the past year make it impossible to ascribe his success merely to luck. We find, among a number of authorities, the feeling that he has hit upon a sound idea which, as it is developed, may prove the solution of long-term weather forecast.

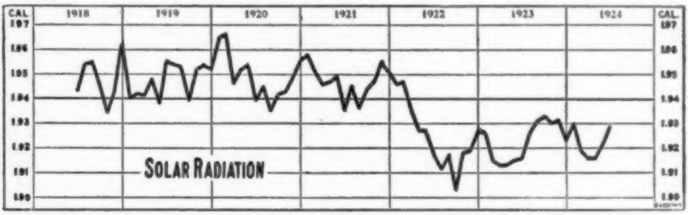
We have long had weather data collected on land. Now it seems necessary to collect data on the oceans. The influence of ocean currents and cold areas in determining climate is well known. It is now believed by many that the temperature of ocean currents change with the solar changes, and in turn, controls land weather. Heretofore this possibility has not been taken much into account.

The usual course of weather forecasting is based on atmospheric studies. or in other words, depends on the telegraph being able to beat the winds. Scientists now, however, are making a more intensive study of ocean temperatures as the determining control of most weather phenomena.

The basis of "long-distance" forecasts is chiefly the variations of the sun's heat. The variations in the sun's heat have been measured by Dr. C. G. Abbot of the Smithsonian Astrophysical Observatory, for the last six years, and the variations found are indicated on the solar radiation chart. The work has been

* Based on notes from a recent article by Roger W. Babson.

concentrated on judging the effect which these changes in solar heat have on ocean temperatures, tracing these changes in the ocean currents, and finally interpreting their effects on inland weather through their influence on moisture-bearing winds towards the land. Because the oceans are slow to respond to changes in solar radiation,



Monthly mean solar radiation values, in terms of calories per square centimeter per minute at earth's mean distance from the sun. Computed by Dr. C. G. Abbot of the Smithsonian Astrophysical Observatory.

Examination of the solar radiation chart shows that from November, 1921, the solar constant began a decline of 1.955 calories to 1.903, September, 1922, the lowest mean recorded since the beginning of observations in 1905. Save for a brief upturn in the summer of 1923, it has continued at relatively low levels, averaging for the first half of 1924, the latest available figures, 1.922 calories. The oceans have not yet had time fully to respond to this drop, so their temperatures from 1925-1926 promise to be still lower than at present. Moreover, even a further decline in temperature is forecast for the Atlantic and Pacific oceans in 1926-1927. It is believed that these lower ocean temperatures should cause abnormal weather, with tendencies to low temperatures. Also, inasmuch as colder ocean water coincident with a low solar constant reduces evaporation, it consequently should mean reduced precipitation. Sectional exceptions to this general statement are probable, but, taking the country as a whole, a precipitation below average is expected.

From the data now available, we may expect a long, severe winter throughout the northern United States and Canada, and, in fact, throughout the whole northern hemisphere. Early cold waves may reach the Gulf Coast in January, so that it may be wise to postpone for a month early vegetable planting in that region. Farmers in the northern half of the corn belt are advised to secure early maturing varieties of seed corn,

because the 1925 season may be materially shortened by late frost next spring and early killing frost in September, 1925.

The value of such forecasts is apparent. If, as is indicated, we are to have a very cold winter, business in heavy clothing, overshoes, and heating aapparatus should be stimulated, and dealers should lay in an adequate stock for a severe winter. Building construction should be completed early. The general public should lay in an ample supply of coal as soon as possible. A dry season will affect crops. Inasmuch as this season's harvests are nearly all determined, this phase of the subject will not become urgent until next spring. Everyone, however, should be intensely interested in watching the progress of these new weather studies.

Laveran, 1845 - 1922.*

METHODICAL, indefatigable industry, stimulated by a Gallic imagination, and a high moral courage tempered by a scrupulous, scientific honesty, was the outstanding feature of the character of Laveran, whose life of wonderful accomplishment has only recently drawn to a close. He gave to the world the mastery of the disease which caused the decadence and fall of Greece and Rome, and opened the most insalubrious regions of the world to the enterprise of man. As a result of his labors the Panama Canal became an actuality and great fertile but uninhabited areas in many parts of the world, which lay waste by reason of an eon-old endemic, were opened to colonization and transformed into healthful and productive gardens. His discovery of the causal agent of malaria blazed the trail to the rational prophylaxis and eradication of the disease, thus constituting a basic addition to the sum of human knowledge and another safeguard to human existence.

Science has lost one of its most illustrious servants and France one of the most brilliant names which ever illuminated the already dazzling page of that nation's scientific achievements. That simple, modest son of an army medical inspector, alumnus of the School of Strassburg, teacher and director at Val-de-Grace, army medical officer, worker at the Pasteur In-

* From "The Nation's Health," October, 1922.

stitute, labored in the cause of humanity to the end of his seventy-seven years, and, weighted with every honor which science and a grateful world could bestow upon him, passed into the company of the medical immortals, leaving behind him a world which was safer and healthier than he found it, a name which will never be forgotten, and an example for all who would serve their fellow men.

From the beginning of his medical life, Laveran set for himself the invariable rules of punctual, methodical work each day, scrupulous care in the fulfilling of his scientific and moral duties, tenacity in research and exactness in observation, and an invariable probity in the expression of that which he had seen and proven. In 1875 he published a treatise on "The Diseases and Epidemics of Armies," growing out of his lectures at Val-de-Grace, and on November 23, 1880, presented to the Academy of Medicine his first note "Upon a New Parasite Found in the Blood of Many Patients Attacked by Palustral Fever." This note and those following it, addressed to the same body and to the Academy of Sciences, passed almost unnoticed in France at the time, but today they are considered historical events of the first order.

Pasteur was revolutionizing medical doctrines. The causation of disease by the multiplication of a living virus in the living body had captured the imagination of the scientific world. Microbes, bacilli, bacteria, micrococci, were being everywhere sought, and the Italian physicians, following the methods of Pasteur, were describing a bacterial cause of malaria. Laveran, after an excellent training in microscopy, had just been sent from Val-de-Grace to Algeria, where malaria was the dominant endemic. The melanemia of the patient was then the enigmatic signature of paludism, and Laveran attacked the problem with the idea of discovering how this pigment was formed. In the course of his daily examinations he observed near the melaniferous leucocytes, spherical, hyaline corpuscles, non-nucleated and pigmented and in very characteristic crescents. "I had seen these things in my examinations," said he, and I hesitated to believe that these elements were parasites. However, on November 6, 1880, in examining the spherical, pigmented bodies, I observed from the borders of many of them mobile filaments or flagellae having extremely active and varied

movements, thus leaving no doubt as to the animal nature of these elements." This conviction grows from day to day as he notes the constant presence of these same elements in the blood of patients suffering from malaria. He collects his data; he describes and draws the organisms with his customary sincerity; he announces without hesitation its specificity, an act requiring a splendid audacity and self-confidence thus to announce the discovery of the first example of a sporozoon pathogenic for man, a new and unclassified organism. Naturally the idea was received with scepticism and incredulity. Laveran with perseverance and unshakable faith accumulated further facts and confirmatory data from many parts of the world, and on December 30, 1889, the Academy of Science voted him the Breant prize.

After the discovery of the hematazoon of malaria, Laveran sought to ascertain its residence outside the body of the sick, its manner of leaving its habitat to infect the well, the agency by which malaria is spread, and in 1884, reasoning from the discovery of Sir Patrick Manson that mosquitos spread filiariasis, he suggested the existence of an intermediate host in malaria. Followed the work of Ronald Ross, of Bignami and Bastianelli, of Grassi, of Manson and Ross, and of many others, and the prophylaxis and eradication of malaria was placed upon a scientific basis and became wholly realizable.

Laveran was elected to the Academy of Medicine in 1893, to the Academy of Sciences in 1901, and in 1907 received the Nobel prize. From 1896 to the day of his death he worked at the Pasteur Institute on the pathogenic protozoa of man and animals, and in 1912 published his very valuable work on the subject. The War found him too old for service with the colors, but he continued without intermission his labors in the almost deserted laboratories and in 1917 published his splendid book on Leishmaniasis. He founded the Society of Tropical Pathology and presided over its destinies for twelve years, and at the time of the centenary of the Academy of Medicine he was its President. Retiring in 1921, he continued nevertheless to follow and direct his research laboratory at the Institute, and death alone was able to impose upon this indefatigable worker a definite rest.

Ch. I. Chardonnet

FATHER OF THE ARTIFICIAL SILK INDUSTRY.*

On March 11, 1924, Count Chardonnet died in France at the age of 84 years. Not France alone, but the whole world of science and the textile industry loses an outstanding figure. Because of the success of Chardonnet in overcoming many obstacles and finally perfecting a process of making a thread from cellulose nitrate, he is called the "Father of the Artificial Silk Industry." The above portrait is that of Count Chardonnet. taken ten years ago, when he was still active in his chosen field.

The trade-mark of the Chardonnet company has been in use 20 years. It is typical of the artificial silk industry, in that it shows a chemical flask resting upon the twisted fibers of artificial silk and two silkworms crawling up the outside, as if to investigate or subdue their new rival.

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* By courtesy of the National Aniline and Chemical Company.

Resuscitation After Electrical Shock*

WILLS MACLACHLAN, Toronto.

AN old Chinese maxin says: "When you put on your clothes remember the labor of the weaver; when you eat your daily bread, think of the hardships of the husbandman." If written today, it might well have added: "When you turn on the light, remember the work of the lineman and the operator." It is in the interest of these men that I would discuss resuscitation after electrical shock. It is not entirely without reason that the electrical profession and industry look to the medical profession for special consideration and assistance. One need only mention the great boon to physicians the now known electrical helps, such as the roentgen ray, are, to say nothing of the future.

In studying the question of electrical shock, certain points stand out. If an electrical current flows from foot to foot, practically no effect will be noticed. If, however, it flows from hand to hand, serious results will ensue. In other words, if the path of the current passes through the thorax, a shock will naturally occur.

If the parts of the body that are in contact with the conductors are dry, a less severe shock will be felt than if the contacts are wet. From this one can see the cause of severe shocks and fatalities from comparatively low voltage circuits in bath rooms.

In low voltage shocks, the effect is usually to cause fibrillation of the heart; in higher voltage shock cases, at first the heart is not involved, but paresis of the respiratory center occurs. In practice, shocks below 220 volts cause fibrillation of the heart, while in shocks of more than 1,000 volts there is little if any immediate effect on the heart, the effect being almost wholly confined to the respiratory center.

Owing to shortness of time, I must leave this subject, but I would direct interest to the lectures by Jex-Blake,† a refer-

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* From Journal American Medical Assn., Sept. 6, 1924.

† Jex-Blake, A. J., Death by Electric Currents and by Lightning, Goulstonian Lecturer, Royal College of Physicians, London, Brit. M. J., March 1, 8, 15 and 22, 1913.

ence very little used on this side of the Atlantic, in regard to electrical shock.

From earliest times, various methods of resuscitation have been put forward. These have been more or less efficient. Two years after the discovery of oxygen, an apparatus using two bellows and feeding oxygen to the patient was used in resuscitation from drowning. In 1829 this method was condemned by the Royal Humane Society, and the bellows were relegated to the fireside. From 1857 to 1903, four important manual methods of resuscitation were promulgated, those of Schäfer and Silvester being the best known. In America little was known of the Schäfer method until Dr. Schäfer presented the Harvey Lecture in 1909, the Silvester method being universally used and taught in medical schools. Since 1909 several commissions have investigated various mechanical and manual methods of resucitation, and have uniformly recommended the prone-pressure method.

Various authorities have attempted to evaluate the volume of exchanged air due to the various methods. Owing to the fact that there are a number of variables difficult to reproduce and that the mechanics of the lungs of a person suffering from electric shock, drowning or gas-poisoning are difficult to reproduce, to say the least, very different results have been obtained. This, however, has been proved, that the exchange of air which results from the prone-pressure method is quite sufficient to maintain life.

It is unnecessary for me to explain the mechanics of the chest here, but it may not be out of place to draw attention to the fact that the prone-pressure method more nearly imitates the natural process of breathing than does any other method. It might further be pointed out that it is the easiest method to perform and the least fatiguing, and that it can be performed by one person without assistance.

In the public utility industry, the men are usually scattered in comparatively small groups, often miles away from their headquarters. If provision is to be made for resuscitation, it must be of such a nature that it is always readily available and simple, so that it can be made use of instantly by the average man. It must also be effective, because the saving of a

life is at stake, and inefficiency cannot be tolerated.

Having this problem before it, the National Electric Light Association has standardized on the prone-pressure method, and the member companies have had many thousands of employees trained in it and required to practice it regularly. The result has been that the lives of a number of employees and the public have been saved as a result of the training and practice.

As a method of recognition, a medal known as the Insull medal has been awarded in meritorious cases. The details of one case may be of interest.

REPORT OF CASE.

Feb. 20, 1923, S. L. S., a patrolman employed by the Texas Power and Light Company, and his wife were motoring along a road near Irving, Texas. The man stopped the car and went to take some measurements on a high-tension line, and in so doing received a shock that rendered him unconscious. He stopped breathing. Mrs. S. had been trained in resuscitation and immediately went to her husband's assistance. By persevering in applying the method, she was able to resuscitate him. She then assisted him to the truck, and drove the truck into the nearest town, where he was transferred to an ambulance. Her remark on being presented with the Insull medal was: "By knowledge of this method, I have Steve to share the honor with me."

These awards are made only after a very careful investigation into the facts, and the examination of reports made under oath.

The electrical profession and industry are not unmindful of the assistance of the American Medical Association and physicians generally in coping with the question of resuscitation. It feels that since it has assisted in the research and also has trained its employees and insisted that they maintain their efficiency by practice, it can ask for further assistance from the medical profession.

At the time of an accident the patient is cleared from the current and resuscitation started at once. Then a call is sent for a physician. When he arrives he will usually find men perfectly competent to perform resuscitation carrying out their instructions, and he can be of inestimable value if he can sustain their morale by encouragement and not change the method. The patient's mouth and throat should be cleared, a suitable hypodermic injection given, and measures taken to keep the patient warm. It is wise to withhold morphin until the patient is breathing.

Jex-Blake says: "Nothing less than cooling of the body or the onset of rigor mortis should be taken as evidence of death here." The men have instructions to continue resuscitation until the patient breathes or the onset of rigor mortis. This may be an extreme view, but no harm can occur· It is a general view that resuscitations in the past have been stopped too soon. Authentic cases are on record of patients, after being declared dead, being resuscitated and regaining their former health.

Is it too much to ask, when we have obtained advice as to the best method, had our men trained in the method and require them to practice it, that the attending physician co-operate in sustaining their morale and use every effort to save the life in the balance?

In many papers on resuscitation it is taken for granted that the method is so well known that it would be a waste of time to give details. However, a demonstration of the method may not be out of place, and details can more readily be shown.

Prone-Pressure Method.

The victim should be quickly released from the current, care being taken to avoid receiving a shock. Any dry non-conductor (rubber gloves, clothing, wood or rope) may be used to move either the victim or the conductor. Metal or any moist material should not be used. If both the victim's hands are grasping live conductors, an effort should be made to free them one at a time. If necessary, the current should be shut off. The nearest switch should be opened, if that is the quickest way to break the circuit. If it is necessary to cut a live wire, an ax or a hatchet with a dry wooden handle should be used, the face being turned away to protect it from an electrical flash.

As soon as the victim is clear of the live conductor, a finger should be put in his mouth and throat to remove any foreign body, such as tobacco or false teeth. If the mouth is tight shut, no attention should be paid to the foregoing instruction until later, but resuscitation should be immediately begun. The patient will breathe through the nose, and, after resuscitation has been carried on a short time, the jaws will probably relax, and any foreign substance in the mouth can then be removed. No time should be taken to loosen the patient's clothing as *every moment of delay is serious.*

The patient should be laid on the abdomen, one arm extended directly overhead, the other arm bent at the elbow, and with the face resting on the hand or the forearm so that the nose and mouth are free for breathing (Fig. 1).

Fig. 1. Hands in position, pressure off.

The resuscitator should kneel, straddling the patient's hips, with the knees just below the patient's hip-bones or the opening of the trousers' pockets. The palms of the hands should be placed on the small of the back, with the fingers resting on the ribs, the little finger just touching the lowest rib, the thumb alongside the fingers, the tips of the fingers just out of sight (Fig. 1).

With the arms held straight, the resuscitator should swing forward slowly so that the weight of his body is gradually brought to bear on the subject (Fig. 2). This operation, which should take from two to three seconds, must not be violent, as internal organs may be injured. The lower part of the chest and also the abdomen are thus compressed, and the air is forced out of the lungs; the diaphragm is kept in natural motion; other organs are massaged, and the circulaton of the blood is accelerated.

Now the resuscitator should immediately swing backward so as completely to remove the pressure, thus returning to the position shown in Fig. 1. Through elasticity, the chest wall expands and, the pressure being removed, the diaphragm descends, and the lungs are thus supplied with fresh air.

After two seconds, the resuscitator should wing forward again. Thus the double movement of compression and release

should be deliberately repeated from twelve to fifteen times a minute, a complete respiration being made in four or five seconds. If a watch or a clock is not visible, the natural rate of the resuscitator's own deep breathing should be followed. The proper rate may be determined by counting,—swing forward with each expiration and backward with each inspiration.

As soon as this artificial respiration has been started, and while it is being continued, an assistant should loosen any tight clothing about the patient's neck, chest and waist. The patient should be kept warm. Ammonia should be placed near the nose, the safe distance being determined by first trying how near it

Fig. 2. Pressure on.

may be held to the resuscitator's own nose. No liquids whatever should be given by mouth until the patient is fully conscious.

Artificial respiration should be continued without interruption (if necessary for four hours) until natural breathing is restored. Cases are on record of success after three and one-half hours of effort. The ordinary tests for death are not conclusive in cases of electrical shock.

When the patient revives, he should be kept lying down and not allowed to get up or to be raised under any consideration. The patient should then have any other injuries attended to, and he should be kept warm, being placed in the most comfortable position.

Resuscitation should be carried on at the nearest possible point to which the patient received his injuries. He should not be moved from this point until he is breathing normally of his own volition, and then should be moved only in a lying

position. Should it be necessary, owing to extreme weather conditions, to move the patient before he is breathing normally, he should be kept in a prone position and placed on a hard surface (door or shutter or the floor of a conveyance), resuscitation being carried on during the time he is being moved.

A brief return of spontaneous respiration is not a certain indication for terminating treatment. Not infrequently the patient, after a temporary recovery of respiration, stops breathing again. The patient must be watched, and if normal breathing stops, artificial respiration should be resumed at once.

Those responsible for the minimizing of the effects of electrical shock know well that the last word has not been said on the subject. They know, however, that in regard to the setting up of artificial respiration, the prone-pressure method has proved to be the most efficient and the easiest to teach to men and to carry out. There are other points that need careful study, such as correcting the fibrillation of the heart and shortening the duration of the paralysis of the respiratory center. Careful research work is needed here.

Resuscitation from Carbon Monoxid Asphyxia, from Ether or Alcohol Intoxication, and from Respiratory Failure Due to Other Causes*

YANDEL HENDERSON, New Haven, Conn.

A LARGE proportion of all deaths, perhaps the majority from all ultimate causes, are immediately due to failure of respiration. The prevention of even a small fraction of them will amount in the aggregate to the saving of a very large number of lives. The procedures and apparatus of which I shall speak have already demonstrated their capacity to save these lives, and probably more. The methods lie in a nearly new field of therapeutics, a field which we may call inhalational therapy. It is sometimes a useful accessory and sequel to artificial respiration. But is is of much greater scope than mere artificial respiration.

* For full article see Jour. American Medical Assn., Sept. 6, 1924.

Manual Artificial Respiration.

Others are to deal primarily with the topic of artificial respiration. I will merely add my testimony to theirs in support of the conclusion reached by every one of the scientific commissions that have studied this subject. This conclusion is that, for the treatment of electric shock, drowning, and other conditions producing complete cessation of breathing, the Schäfer manual prone-pressure method should be used in preference to any other. The use of artificial respiration apparatus should be discouraged, for the simple manual method is much more effective. There is some evidence that mechanical devices may even be injurious to the lungs. These apparatus have few, if any, well substantiated cases of resuscitation to their credit. On the other hand, hundreds of lives have been saved with the manual method.

It is essential that the medical profession should learn the prone-pressure method and should realize the importance of applying it immediately in all cases in which respiration has been stopped by an electric shock, drowning or asphyxia. All employees of electric light companies and telephone companies, all boy scouts, and a large number of the better-trained policemen and firemen now know how to administer the prone-pressure method. It is sometimes charged against the medical profession that in cases of drowning and electric shock, in which lives probably could be saved by the immediate and continued application of this most effective method of artificial respiration, lives have been lost because the first physician who reached the case was unacquainted with the method. He has therefore ordered the electric lineman or policeman or boy scout who was administering the prone-pressure method effectively and was well on the way to saving life, to desist. He has then either declared the patient dead or has called an ambulance and sent him to the hospital, where he arrived dead. If there is any basis for this charge, it is time that the medical profession removed it by learning the prone-pressure method.

It is only fair to add that, in ordinary medical practice, a physician in the past has rarely seen cases requiring artificial respiration. Often he fails to realize that a perfectly healthy young man, whose breathing has been temporarily stopped by

an electric shock or by immersion in water, is a very different subject from the patient who stops breathing after a long and wasting, or acute and destructive, illness. Often, in the drowning or electric cases, the vital machine merely needs to be started again. It is like cranking an automobile when the engine has stalled and the self-starter is out of order.

With the increasing use of electricity, not only for transportation and industry, but also in our homes, for light, for cooking, and, most dangerous, for the laundry, electric shock has come to be one of the ordinary hazards of modern life, and everyone should know how to render first aid. The essentials of artificial respiration are, that it should be applied without the loss of a moment, without waiting to telephone or send for apparatus, and that, even if the patient is at first pulseless and apparently dead, it should be continued for three hours, or until spontaneous breathing returns, or rigor mortis develops.

* * * * *

PREVENTION OF RESPIRATORY FAILURE.

The main topic to which I wish particularly to call attention is a broad one, and occurs repeatedly in the experience of every physician and continually in every hospital. It is that of preventing failure of respiration. It applies, with variations, to carbon monoxid asphyxia, to acute intoxication under alcohol and many other volatile poisons, to the depression following anesthesia, to morphin poisoning, to asphyxia of the new-born infant, and to a number of other conditions. It has, in fact, very wide applications in most of the branches of medicine and surgery.

Suppose that we are confronted with a case of the types just mentioned, in which death from respiratory failure is threatening or evidently approaching. There is no need as yet for artificial respiration, for natural breathing still continues, but it is growing weaker. When it stops it will be too late. How are we to reason regarding such a case? What are we to do to effect resuscitation and restoration to normal life?

First, we know now that the stimulant which Nature herself uses to maintain breathing is carbon dioxid. It is the increased production of carbon dioxid during muscular exercise that causes the corresponding increase in the volume of air breathed.

It thus provides the increased supply of oxygen to meet the increased need. Conversely, if the carbon dioxid in the blood is abnormally decreased by excessive breathing, we know from well-established experiments that respiration is liable to stop until the normal amount of carbon dioxid reaccumulates in the blood and again stimulates the respiratory center.

Secondly, we know that oxygen deficiency, if at all intense, acts as a sort of whip, which excites respiration to activity, and even to excessive activity, but injures at the same time and is liable to be followed by a subsequent period of depressed breathing.

Thirdly, and no less important, we know that pure oxygen, or air enriched with oxygen, its not a respiratory stimulant. On the contrary, under some conditions it is, in effect, a powerful depressant of breathing. Many years ago Mosso observed what he called "oxygen apnea," or cessation of breathing induced by oxygen. From the observations of Haldane and his collaborators and from my own work, the following partial explanation or, rather, description of this important phenomena may be offered. When a man or animal is exposed to a deficiency of oxygen for a time, his breathing is greatly augmented and he blows off more carbon dioxid than the body can well afford to lose from its store of carbonic acid and bicarbonates. If, then, he is suddenly given oxygen, or even merely fresh air, a marked decrease in respiration occurs. The breathing may even stop entirely. I have seen death follow in an animal given pure oxygen suddenly after incomplete carbon monoxid aspsyxia. It is well known to the men in our city fire departments that a man who has been workng in the fumes of a burning building often collapses when he comes out into fresh air. The same effect is known among mine rescue crews. Often they walk out of the gases in a burning mine with fair vigor and coordination of movement, but fall unconscious after drawing a few breaths of fresh air. In the laboratory, animals that have been kept in a gassing chamber until slightly groggy with carbon monoxid sometimes collapse when removed into fresh air. Similarly, athletes seldom collapse during a competition, but when the race is over, with its strain on the oxygen-supplying power of lungs and heart, they pant heavily for a few minutes, and then collapse. In all these cases we see

marked depression coincident with abundant oxygen after a period of oxygen deficiency.

It is not possible as yet to give a complete explanation of these events, but we can note their similarities and recognize that certain features are common to nearly all of them. Probably in all cases of excessive blowing off of carbon dioxid occurs during the period of oxygen deficiency and excessive breathing. The deficiency of oxygen meanwhile, either by itself or through some incomplete combustion product, keeps respiration working, and working even excessively. But when a full supply of oxygen is renewed, this anoxemic stimulus is removed. The deficiency of carbon dioxid then allows respiration to fail.

The condition of deficiency of carbon dioxid is called "acapnia," from the Greek *kapnos,* smoke. Literally, acapnia means smokelessness. It tends to be overcome spontaneously as the carbon dioxid produced in the body reaccumulates in the blood. But this may require a long period, and while the condition lasts it profoundly disturbs the acid-alkali balance in the blood. It forces alkali out of the blood and may induce an extreme and rapid decrease in the alkali reserve. It thus induces what is now called acidosis.

It used to be common to think that deficiency of oxygen was necessarily associated with excess of carbon dioxid in the blood. This may perhaps be the case in drowning, but under nearly all clinical conditions we actually find anoxemia and acapnia associated. This combination of deficiency both of oxygen and of carbon dioxid is capable of inducing profound functional disturbances. Not only is the blood alkali lowered, but such conditions as edema of the brain and congestion of the lungs may result. Space forbids a full account or an attempt at analysis of this combination of interacting causes. Let us rather turn to the question as to the conditions under which they occur and the effective method of resuscitation.

Obviously, inhalation of oxygen alone is not, under such conditions, a logical procedure. Only in pneumonia must we recognize an exception to this statement. Under nearly all other conditions, oxygen administered for purposes of resuscitation should contain also a sufficient amount of carbon dioxid to stimulate the breathing. Uusually, 5 per cent of carbon

dioxid is sufficient in from 90 to 95 per cent of oxygen. It is the use of this mixture, administered by a special type of inhaler, the so-called "H. H. inhalator," devised by us, which is the essential feature of the treatment introduced by my associate, Dr. H. W. Haggard, and myself and approved by the last resuscitation commission.

CARBON MONOXID ASPHYXIA.

The field in which inhalation of oxygen plus carbon dioxid has made its most definite and extensive success is that of carbon monoxid asphyxia. In nearly all our cities the number of deaths from this cause is large. It is exceeded only by a few of the most important diseases; and, unlike most diseases, deaths from carbon monoxid are steadily increasing in number. As a cause of mortality it is nearly as important as diabetes. Carbon monoxid has probably displaced lead as the most important industrial poison. More than 400 deaths a year are assigned in New York City to the city gas. The public demands cheap gas; cheap gas means a high content of carbon monoxid,—and the fatalities rise accordingly. It is quite possible that, by scientific research, improvements in gas manufacture could be developed that would afford a gas for lighting, heating and cooking with distinct economic advantages (higher in methane and lower in carbon monoxid) and at the same time much less poisonous. If the carbon monoxid content were reduced one-half, the deaths would probably be reduced to a quarter or less of the present figures. But this great industry has as yet no central research institute for such investigations,—an extremely shortsighted policy. I am glad to be able to add, however, that the American Gas Association supplied the funds by which the inhalational treatment of carbon monoxid was developed.

In many industries carbon monoxid is one of the chief health hazards, notably around blast furnaces and in mines. Every stove, in a dwelling house that can be checked to the point of incomplete combustion may give off carbon monoxid and asphixiate its owner and his family. When natural gas is used in imperfect appliances, dangerous amounts of carbon monoxid are produced. In the smoke from burning buildings it is the chief toxic constituent; it is one of the dangers that the city firemen face. It is the chief toxic constituent of automobile exhaust

gas. The 10,000,00 or 15,000,000 automobiles in which we Americans get our transportation, our recreation and our favorite atmosphere, discharge an average of about two cubic feet per car per minute. Even a Ford produces at least a cubic foot of carbon monoxid a minute, enough to render a small closed garage deadly in five minutes. Men who work in garages and repair shops are almost daily subject to partial intoxication by carbon monoxid.

Suppose now that a man is overcome by inhaling a fairly high concentration of carbon monoxid under any of the foregoing conditions; his legs give way under him before he realizes his own condition. If he is fortunate enough to be discovered before death, he is dragged or carried out of the garage, out of the trench in the street, or away from the blast furnace, where he has been working. If he has stopped breathing, his rescuer immediately applies the prone-pressure method. At the same time, another person holds against his face the mask of the inhalator, so that the artificial respiration draws into the lungs the oxygen and carbon dioxid, supplied from a tank in which this mixture of compressed gases is held. The carbon dioxid thus tends to stimulate spontaneous breathing and artificial respiration should then be discontinued, but the inhalation should be continued for from fifteen to thirty minutes longer.

This is not a fanciful account of an imaginary case, but of the actual features of a large and rapidly increasing number of resuscitations of which we have record. There are certain extraordinary sequels. After such a short but acute gassing, a man who survives without having been treated with oxygen and carbon dioxid is always acutely sick, with splitting headache and nausea, lasting for two or three days. Recent investigations in my laboratory have afforded strong evidence from animal experiments that this headache is due to a congestion and edema of the brain. On the other hand, our records show that men who have suffered a short but acute gassing and have then been treated with oxygen and carbon dioxid, often escape this headache and nausea almost entirely.

* * * * *

When a fireman is overcome by smoke, a short inhalation will not only prevent illness and save him, perhaps, from a

damaged heart; it also will enable him to go back to work and help put out the fire. As regards the use of an inhalator on the ambulance, experience is showing that it helps to save life until the patient can be brought to the hospital, not only in cases of asphixia, but in a wide variety of forms of respiratory failure, including even concussion of the brain.

In the treatment of cases of prolonged asphyxia, in which the gas has been turned on all night, such brilliant results cannot be expected. We were at first doubtful regarding the extent of benefit that could be expected. Accumulating cases show, however, that even after prolonged asphyxia and after the loss of time involved in calling an ambulance and sending a patient to the hospital, the inhalation treatment may still be of great benefit in preventing such sequelae as nerve degenerations and the pneumonia which heretofore has been common.

An elderly man and his wife, living in a small houseboat, were asphyxiated by the fumes from a stove. The woman was dead when found in the morning, the man comatose. A couple of hours later, in the hospital, the man's blood still contained 52 per cent. of carbon monoxid, and artificial respiration had several times been necessary to prevent death in the ambulance. Oxygen and carbon dioxid mixed in a Tissot spirometer were then administered for two hours. Normal breathing returned and the carbon monoxid in the blood was reduced to 11 per cent. Four hours later, the patient was conscious, although stupid. He made an uneventful recovery, and walked home on the seventh day.

When we began using this treatment, we were at first afraid that it might overwork the heart; but experience has demonstrated that there is no such risk. The stimulation is a very mild one. Perhaps the most surprising and gratifying result has been the prevention of postasphyxial pneumonia, which this treatment evidently effects. Heretofore, as nearly as we can estimate, about one-third of all persons severely gassed but not dying under asphyxia, have later died in the hospital from pneumonia.

* * * * *

The chief principle of this therapy is that of using a mixture of oxygen and carbon dioxid. Carbon dioxid to stimulate the respiratory mechanism to full deep breathing; to flush and flood the blood in the lungs with oxygen and to ventilate out of the blood any volatile toxic substance. To combat respiratory failure in this way is to use Nature's own agencies to assist Nature toward recovery.

The Science Lesson Plan

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A. Statement of Purpose.

The short time allotted to the discussion of this topic led to the writing of this paper, rather than trusting to an oral discussion, in order that the thoughts might be expressed clearly, briefly and accurately. We are very much impressed with the need of a careful consideration of this topic, because of its great importance in producing efficient science teaching, and because so much poor science teaching is done by even the best teachers through failure to make and follow good lesson plans. We science teachers cannot work at highest efficiency without following efficient *lesson plans*. If our discussion results in the making of more and better plans, its purpose will have been accomplished.

B. The Importance of Science Instruction.

The leading position that science holds in modern education and life is so vital, that we, as teachers of that important subject, should never lose sight of our splendid opportunity to do a great work in the scientific education of the rising generation. The ever-present consciousness of the importance and necessity of elementary science knowledge should be a constant encouragement and cheer to us. And yet, sometimes for weeks at a time, we let the rush of school duties and the weight of classroom worries drive from our minds the encouraging and inspiring thought of our wonderful opportunity. For this reason we are speaking briefly of the importance of science. Abraham Flexnor felt this fact, and stated that "the work in science should be the central and dominating feature of the school." In the Cleveland survey we read the following pointed statement: "Considered from the standpoint of actual human needs, the children in this ultra-scientific age need to possess a working knowledge of the rudiments of science if they are to make their lives effective." Trafton says emphatically that "If the child has *not* had instruction in that subject, he has missed a

vital part of his life, as a result of which he will be *handicapped always*. He cannot himself derive as much pleasure from life. He cannot be so successful, nor can he be of so much service to others." So we should take comfort and courage from the fact that we are occupied in a great work, and constantly seek to accomplish that work with the greatest efficiency.

C. THE AIMS OF SCIENCE TEACHING.

Efficiency in teaching and in planning the science lesson will be further aided by frequently remembering the aims of science instruction. An author has said, "The aims of any subject should be as broad as life itself, in as far as that subject touches the various phases of life. Science is so closely related to many vital aspects of human life that the aims of science teaching must be broad and comprehensive." Briefly stated, some of these aims are as follows:

1. *The avocational aim*, whereby science furnishes greater pleasure in living, through the pursuit of hobbies in leisure hours and creating new interests in life.
2. *The social aim*. Science teaches duties in connection with social and community life, creating a spirit of co-operation in the welfare of all.
3. *The economic aim*, producing preparation for work in various occupations.
4. *The hygienic aim*, resulting in creating a desire for a healthy, strong body.

Other aims and purposes of science teaching might be mentioned if time permitted.

D. NEED OF THE SCIENCE LESSON PLAN.

The realization of the importance and necessity of science knowledge and training in life, and the consciousness of the aims of science teaching, show us the need of carefully *planning* the science lesson so that the children may be *equipped* for the demands of modern life.

E. RESULTS OF CAREFUL PLANNING.

Careful lesson planning, combined with efficient execution of the plans, will produce the following good results:

1. The *attention* of the class will be held because the pupils clearly see the purpose and progress of the lesson, and realize that there is something *worth-while* and *interesting* to be done in *every minute* of the class period.
2. The science facts will be *impressed* on the minds of the pupils because those facts are made interesting and clear and their relation to a definite problem is shown.

3. The class period for the teacher will be more *pleasant* and far more easy, because of the attention and interest and progress of the class, which will, of course, also result in disciplinary trouble.
4. There will be less *waste of time* in the class period. Rapid completion of parts in the lesson, or quick changes from one part to another, cannot be accomplished without a definite plan. So, the term's work, assigned to the class, will be completed more quickly and thoroughly.

There are other good results of following a definite plan which I will not take time to enumerate here.

F. HOW TO BEGIN A PLAN.

Authorities sem to agree that a lesson plan should center around one topic, or project, which should be stated as the *"pupils' problem,"* so that it can be impressed upon the children as their *own* problem. It will help to arouse their interest and motivate their investigation. It will also help the teacher in selecting and organizing the subject matter. When this central part has been chosen, the rest of the plan can be constructed around it. Therefore, to begin making out a set of lesson plans on a general subject like plant life, the first step would be to make a list of the worth-while sub-topics, or important problems, to be investigated, such as roots, flowers, leaves, etc. Then, state these in the form of *pupils' problems,* such as: "Why must a tree have roots?" or "Why does it hurt a plant to pull off its leaves?" Around these problems unit lessons can be constructed, and composed of whatever parts seem necessary. To further illustrate,—the *planets* might be taken as a sub-topic in the study of the heavens. The pupils' problem could be: "Are the planets like our earth?" or "Do trees, animals and people live on the planets?" To investigate and solve those problems, the pupils must necessarily find out about the shape, size, condition, position and distance of the planets. Directions for conducting this investigation need to be planned and presented by the teacher, and also other parts of the lesson should be prepared. Thus, we may now take up the consideration of what may constitute a rather complete science lesson plan.

G. PARTS OF THE SCIENCE LESSON PLAN.

The parts of such a plan have been named and briefly discussed on the outline sheets in your hands. We will further consider them in their order on these sheets.

1. REPORTS ON OBSERVATIONS.

This part of the science period can be made very valuable if conducted properly. We have stated that one purpose of science teaching is to arouse *new interests* in the children, so we should lead them to "see and appreciate some of the great variety of beautiful and interesting things which everywhere abound in nature, but which otherwise remain as a closed book to them." The participation of the pupils in this part of the period may be stimulated by causing discussion on the phenomena to be observed, and by giving careful directions beforehand. Reports on *undirected* observations are frequently a waste of time. Constant encouragement and guidance will gradually increase the number of pupils making reports on their observations.

2. THE REVIEW.

Two important purposes of the review are:

(1) To assist in the remembering of important facts.
(2) To correct wrong ideas.

A carefully planned review will best accomplish these purposes, and will cause this part of the period to progress with *snap* and *pep* and *interest,* while otherwise it might drag. Some of the types of review are stated on the outline, as follows:

A. Oral review.
   1. Teacher directing. Questions asked on past—
      (1) Oral work in class.
      (2) Written work in class.
      (3) Reports given in class.
      (4) Trips taken by pupils.
   2. Pupils directing (Socialized review). Review in care of one or more pupils, covering any of the above four kinds of past work. Types of socialized review:—
      (1) Using questions made up by pupils.
      (2) Using questions written up by the teacher.
      (3) Debate lead by two teams arranged beforehand.
      (4) Games based on review questions.

B. Written review.
   Many types of questions requiring long or short answers are frequently used.
      (1) True and false.
      (2) Reading tests.
      (3) Pick the right word.
      (4) Definitions.
      (5) Descriptive questions, etc.

3. MOTIVATION OF THE NEW TOPIC.

Perhaps the most neglected part of the ideal lesson plan is the proper motivation of the new topic or pupils' problem. This is a serious mistake. Trafton states that "One of the first and most *fundamental things* to which the teacher of science should give attention is proper motivation of the subject on the part of the child." "Motivation involves three steps:

1. A consideration of the children's *experiences*, so as to make the proper connections.
2. A *problem* to arouse the children's interest and to guide them in their work.
3. The *use* of what they have learned as the final outcome of what precedes.

"The first essential in proper motivation is that the thing being done should be *worth while* from the child's standpoint." Reading from the outline in your hands:

"Motivation of the new topic, or project, or problem, is the arousing of interest, leading to a *desire* on the part of the pupils to investigate the project. Can be done by creating a *real* problem in their minds as follows:[1]

1. By appealing to the general past experience of the pupils.
2. By referring to points of discussion in past lessons.
3. By showing pupils unexpected or unfamiliar science phenomena.
4. By causing an argument or clash of opinions in class.
5. By many other methods too numerous for this outline.

The above will naturally lead to the 4th part of the plan.

4. THE STATEMENT OF THE PUPILS' PROBLEM.

As expressed on your outline, this problem should be worded briefly, clearly, and in an interesting way. It will help to determine what should be included in the lesson, and how the investigation should be carried on. Since the function and importance of this part has been mentioned under a previous heading, we will pass to the next point.

5. THE NECESSARY DIRECTIONS.

The pupils have been shown their problem clearly, and now need and should *desire* directions, showing how to *investigate* and *solve* it. Methods of investigation are suggested on the outline:

1. By study of books.
2. By demonstrations conducted before the class.
3. By experimentation by each pupil.
4. By oral reading and discussion.
5. By science trips, or other means.

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1 See Trafton, Chap. 4, p. 26, 39.

The giving of directions should take as little time as possible, so that the pupils can start immediately on one or more of the methods to be used in the investigation. Stenciled direction sheets are a great help.

6. THE INVESTIGATION OF THE PROBLEM.

This is frequently termed the "development of the lesson," or the "study time" of the period. Trafton says: "The development should be so planned as to answer the question raised in the problem. Enough points should be included to answer the question satisfactorily and those points which have no bearing on the problem should be omitted." "The most *natural sequence from the child's standpoint* is the order in which the various things should be taken up." Reading from the outline in your hands:

"Investigation is the atempt to solve the problem according to the directions given. Sometimes called the 'study period' of the class hour, especially when the investigation is based on books, demonstrations or experiments. Books in the school library should be used, as well as text books. Demonstrations should be worked by the pupils rather than by the teacher, whenever possible. Investigation to be made on trips should be clearly stated beforehand.

1. *Extra Investigation.* This subdivision is not on the outline under part 6. You might write it in. It might be called the special investigation, or extra assignment, given on correlated work, to be done by the more rapid workers after they have completed the regular assignment.

7. THE SUMMARY OR CONCLUSION.

(Call attention to change in position of parts 8 and 9 on the outline sheets. New terms put last as part 9.)

The summary or conclusion should be a brief summing up of all the facts found to help in the solution of the pupils' problem, in order to fix the correct facts and correct solution of problem in mind.

Sometimes a brief drill on the summary may be necessary.

8. APPLICATION OF LESSON FACTS TO PRACTICAL MATTERS.

"The final step comes in the application or use of what the child has learned. The *use* of knowledge is the *chief end* of education. A lesson without application means wasted

effort. One of the vital things in planning a science lesson is to consider how the child may be encouraged to *make use* of what he has learned." If the problem has not practical application we may well question whether it is worth while presenting at all.

9. NEW SCIENCE TERMS.

In almost every science lesson the pupils will find important, unfamiliar words or phrases, which need to be understood and remembered, thus increasing their science vocabulary. A brief drill on these words is important.

II. GENERAL SUGGESTIONS.

1. ENTIRE PLAN NOT ALWAYS NEEDED FOR A LESSON.

Some general suggestions need to be made in regard to the above plan. First, it is understood, of course, that *all* the parts of a complete lesson plan cannot *always* be used in a single science period. Often a very successful science period may consist of only one or two parts of an ideal plan. One plan may require several periods for completion.

2. SUCCESS DEPENDS UPON TEACHER'S ATTITUDE.

Another suggestion is that the success of *any* plan, of course, depends entirely upon the attitude of the teacher. The cheerful, interested, alert attitude of the teacher toward the class will arouse a *similar* response from the pupils. The tone of voice aids or hinders the holding of attention. We do not agree with those who believe that a quiet tone should be used *all* the time. A quiet tone all the time, or a loud tone *all* the time, soon becomes monotonous. A varied tone, strong and emphatic at times, quiet and conversational at other times, is the ideal. On occasion, even a loud commanding voice may be necessary to impress some fact on a pupil or a class.

3. OBJECTIONS TO WRITTEN PLANS.

a. Of course there are teachers who offer objections to making written plans. One common objection is that the teacher seldom desires to use a plan a *second time,* so only brief notes are made, and these directions after the lesson, with the intention of making a more creditable plan the next time

that the topic is to be taught. To this objection, I would answer that this practice soon becomes a habit hard to break, and furthermore, that if the brief plan, as first used, is not good enough to form at least the basis or part of a second plan on the same ploblem, it is not good enough to be used even the *first* time.

b. Another objection is that making good written plans *requires time and work*. On the other hand, I am convinced that this time and work is more than compensated for by the decreased effort required during the class period, the smoother and more rapid progress of the class, and the resulting increase in the general pleasure and interest derived from the lesson by pupils and teacher. (It is the *business* of the teacher.) No other objections seem to be important enough to be mentioned here.

I. Conclusion.

We will conclude as we began when we stated the purpose of this discussion. If our discussion results in the production of more efficient lesson plans, its purpose has been accomplished.

The following is a suggested teacher's plan sheet to fill the requirements of the *ten-part lesson plan* outlined:

SCIENCE LESSON PLAN.

Date: *Period*: *Grade*:

PROCEDURE	CONTENT
1. Lesson Topic	
2. Observation Reports Time:	
3. Review Time:	
4. Motivation of New Topic Time:	
5. Pupils' Problem	
6. Directions for Investigation Time:	

7. Investigation (Development) or (Study Period) Time:	
8. Summary Time:	
9. Application Time:	
10. New Terms Time:	

Brief explanation of *The Ten Part Plan* suggested for the Science Lesson:[2]

The science lesson plan might include the following parts:

1. REPORTS.—Results of observations by pupils reported to the class. Discussion of what pupils have seen or heard or read on science topics resulting from suggestions or directions given in class. Directed observations are the best. Clear and specific directions are necessary.
2. REVIEW.—Reference to any portions of the previous work in one or more of the following ways:
   - A. *Oral Review.*
     - a. Teacher directing. Question on past—
       1. Oral work in class.
       2. Written work in class.
       3. Reports given in class.
       4. Trips taken by pupils.
     - b. Pupils directing. (Socialized review.) Review in charge of one or more pupils, covering any of the above four kinds of past work. Types of socialized review:
       1. Using questions made up by pupils.
       2. Using questions written up by teacher.
       3. Debate led by two teams arranged beforehand.
       4. Games based on review questions. Baseball—Basketball.
   - B. *Written Review.*
     - a. Many types of questions requiring long or short answers are frequently used. Papers exchanged and corrected by pupils as directed by teacher sometimes.
3. MOTIVATION.—Motivation of the new topic or project or problem being the arousing of interest, leading to a desire on the part of the pupils to investigate the project. Can be done by creating a real problem in their minds as follows:
   - A. By appealing to the general past experience of the pupils.
   - B. By referring to points of discussion in past lessons.
   - C. By showing pupils unexpected or unfamiliar science phenomena.
   - D. By causing an argument or clash of opinions in the class.
   - E. By many other methods too numerous for this outline.

   (The above will naturally lead to the statement in 4th part.)

2 Outline prepared by F. A. Newhall, Madison Junior High School.

4. PUPILS' PROBLEM.—This should be worded briefly, clearly and in an interesting way. It will help to determine what should be included in the lesson.
5. DIRECTIONS.—Directions as to how the pupils are to carry on the investigation of their problems, whether:
   A. By study of books, or
   B. By demonstration conducted before the class, or
   C. By experimentation by each pupil, or
   D. By oral reading and discussion, or
   E. By science trips, or other means.
6. INVESTIGATION.—The attempt to solve the problem according to the directions given. Sometimes called the "Study Period" of the class hour, especially when the investigation is based on books, demonstrations or experiments. Books in school library should be used as well as the text books. Demonstrations should be worked by the pupils, rather than the teacher, whenever possible. Investigation to be made on trips should be clearly stated beforehand. Directions for book study to aid pupils put on board or sheets.
7. SUMMARY.—The summary, or conclusion, should be a brief summing up of all the facts found to help the solution of the pupils' problem, in order to fix the correct facts in mind.
8. APPLICATION.—The application of the important facts discovered to practical matters, such as man's welfare or happiness. "A lesson without application means wasted effort."—Trafton. Show how the children can make use of what they have learned.
9. NEW TERMS.—The new words, terms or phrases, etc., which are to be remembered because of their importance, should be explained. Thus the science vocabulary of the pupils will be increased.

NOTES ON THE ABOVE PLAN.

The above plan has been successfully used in 7th, 8th and 9th grade classes, not only by myself, but by other science teachers, and is the result of personal experience in science classes. Suggestions for its formation and arrangement were obtained also from the following books, which are well worth reading:

1. The Method of the Recitation—McMurray, 1923. Macmillan Co.
2. The Teaching of Science—Trafton. Houghton Mifflin Co.
3. Methods of Teaching—Charters. Row, Peterson Co.
4. The Teacher, the School, the Community—McFee, A. B.
5. How to Study and Teaching How to Study—McMurray. Houghton, Mifflin Co.
6. Methods of Teaching in High Schools—Parker. Ginn & Co.
7. Supervised Study—Hall Quest. Macmillan Co.

The following is a lesson for Eighth Grade, worked out on *The Ten Part Plan*:[3]

1. LESSON TOPIC. THE ROCHESTER GARBAGE REDUCTION PROCESS.
2. REPORTS.—Reports on the inspection of garbage containers and methods of keeping them clean. Suggest trip to reduction plant. Ask pupils to inspect sink-traps.
3. REVIEW.—Facts of Lesson 1.

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3 Outline prepared by F. A. Newhall.

4. MOTIVATION.—Where do the garbage wagons unload? What happens to the garbage then? Does the city get any money from the garbage?
5. PUPILS' PROBLEM.—HOW DOES OUR CITY DISPOSE OF ITS GARBAGE?
6. DIRECTIONS FOR THE INVESTIGATION.
7. STUDY.—1. Read paragraph 30, pp. 13 and 14. State the correct amounts of three substances found in a ton of garbage.
   2. State one fact about the great kettles.
   3. Read paragraph 31. What is pumped into the kettles to dissolve the grease and fat?
   4. What finally becomes of the water in the garbage?
   5. What happens to the germs and odor?
   6. Read paragraph 32. Where does the grease solution go?
   7. What happens to the solvent vapor?
   8. What happens to the dry material left in the kettle?
   9. Read paragraph 33. How is the fat separated from the volatile solvent?
   10. What is the name of this whole process and state three of its advantages?
8. SUMMARY.—State some of the important things that the city has to think of in disposing of the garbage.
9. APPLICATION.—What may happen if tin cans and glass and broken dishes are put into the garbage?
10. NEW TERMS.—Volatile, Solvent, Condense, Vaporize, Evaporate, Solution, Distillation, Boiling point of water 212°F., Dehydrate, Unsanitary, Germs.

LESSON TOPICS.—LONGITUDE AND TIME.[4]

REVIEW.—Page 34, paragraph 77.

REPORTS.—Assign seed dispersal. Hear reports on other topics assigned.

REVIEW.—Position of places. Parallels and meridians.

MOTIVATION.—Is it the same time now in Chicago that it is in Rochester? Is it the same time in England? Have discussion of answers. What is the cause of this difference?

DIRECTIONS.—Answer the following questions as you study the text.

STUDY.—1. How many degrees does the earth rotate in 24 hours? (page 34).
   Then how many degrees in one hour, and in one minute?
   2. How can we know the difference in time between two places?
   3. Do the people east of us see the sun rise at the same time that we do? Why?
   4. What is the difference in longitude between Boston and Rochester?
   What is the difference in time between Boston and Rochester?
   5. The longitude of Rochester is 77 west, that of Chicago is 87 west; what is the difference in time?
   6. The longitude of San Francisco is about 122 west; how does the time differ from that in our city?
   7. The difference in time between Rochester and Denver is about two hours; what is the longitude of Denver?

EXTRA ASSIGNMENT.—Hodgdon, pp. 454 to 468.
   1. Read the above reference.
   2. Look up in the 8th grade text the meaning of:
      a. Sidereal Day.
      b. Astronomical Day.
      c. Civil Day.
      d. Mean Solar Day.

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4 Lesson plan prepared by Mr. Newhall and Mr. Davis.

SUMMARY.—Discuss the relation of longitude and time.

APPLICATION.—Practical points on the topic.

NEW TERMS.—Time zones.

LESSON TOPIC.—ACIDS AND ALKALIES.

REFERENCE.—Text, page 3.

REPORTS.—Hear reports on kinds of soaps. Pupils to bring samples of soap to class, and to find out the cost of soap and sizes.

REVIEW.—Discuss last lesson. Points in regard to home sanitation.

MOTIVATION.—Can you name some acids? How do acids taste? Is there something just the opposite of an acid? What science deals with acids? We are going to work some experiments in this science.

PUPILS' PROBLEM.—WHAT CAN WE DO WITH ACIDS AND ALKALIES?

ADVANCED WORK.—A. Have the *experiment* on acids and alkalies worked before the class. See direction sheet, and give copies of this to each pupil

B. Study of acids and alkalies.

1. Study page 3 of the manual. How does the chemist classify many substances?
2. State two ways of knowing an acid.
3. State two ways of knowing an alkali.
4. Name three alkalies given at top of page 3.
5. Name two acids.
6. Name four neutral substances. (You should memorize these acids, alkalies, and neutrals.)
7. From what sources are fats and oils obtained?

SUMMARY.—What is the nature of acids and alkalies? How can they be used?

APPLICATION.—Discuss uses of acids, alkalies, neutrals. What to do in case acids or alkalies are spilled on the clothes, on the skin, get in the mouth, in the stomach, in the eye.

NEW TERMS.—Lye and alkali. Potash. Potassium hydroxide and sodium hydroxide. Ammonia. Drill on symbols for the above, and for hydrochloric, sulphuric and nitric acids. Vinegar.

GREENHOUSE PROJECT.

PROPAGATION OF PLANTS FROM CUTTINGS.

GENERAL PURPOSE.—To learn about the propagation of plants.

SPECIAL PURPOSE.—To learn how to grow plants from stem cuttings.

MATERIALS.—Any of the following plants: Geraniums, Coleus, Snapdragons, etc.; knife; flower-pots or soil tray or bench in greenhouse.

METHOD.—A. TEACHERS PART (Pupils taking notes).

1. Explain that many valuable plants may be propagated (produced, started) from pieces of the branches as well as from the seeds. So in this way plants may be multiplied.
2. Distribute to class plant stems (branches) having at least 4 or 5 nodes.
3. Explain what nodes are, and their ability to produce leaves, branches and roots.
4. Show how to make a slanting cut through the lowest node on the stem.
5. Show how to count up from this cut end a distance of two or three nodes, and cut off stem just above that node.

6. Explain how all leaves and side branches must be cut off, leaving only half of one upper leaf for breathing purposes.
7. Show the cutting soil (half sand and half soil) into which the cutting is to be put. Give planting directions.

B. PUPILS' PART.

1. Pupils can now make their cuttings.
2. A pencil drawing of one cutting may be made by each pupil.
3. Pupils pass into greenhouse and plant cuttings as directed.
4. Pupils may write up the project as an experiment, either while or after working it.

CONCLUSION.—1. Why should the cut be made at a node?
2. Why should most of the leaves be trimmed off?

NEW WORDS.—1. Node. 2. Propagate.

NOTE.—1. The succulent (soft, juicy) parts of the stem are the best for cuttings. The woody parts are not so apt to grow.

Visualizing the Sciences

MERRITT CRAWFORD, Bray Screen Products, Inc.,
New York City.

As an aid in the teaching of the sciences, the possibilities of visual education are constantly increasing. Difficulties, which hitherto have hampered the teacher in taking the fullest advantage of the great value both to the instructor and the student, possessed by this form of instruction, by reason of the cumbersome character of the machine and slides, the fire hazard, the costliness of the equipment and the expert knowledge required, are steadily being eliminated, with the result that in a comparatively short time no general science course will be complete without some sort of visual training as an adjunct.

Among the latest contributions to this constantly broadening field is the Brayco, a new type of miniature still-picture projector, which uses small strips of standard non-inflammable film, each containing from 50 to 500 separate views, instead of the heavy and fragile glass slides used by the old-fashioned stereopticon. The whole apparatus, together with several thousand pictures, can be put in the drawer of a desk or in the bottom of a small handbag. It will project at any distance, from 30 inches to 30 feet, on any smooth surface, such as the wall, floor or ceiling.

By means of a special insulating device the film is protected from the heat of the lamp, so that a single picture can remain on the screen for hours if need be, if protracted discussion is

desired. On the other hand, the film can be moved backward or forward, so that any picture in the series, wherever located, may be referred to instantly, or a hundred pictures shown in a minute, if it is necessary.

The new machine is the invention of Mr. J. R. Bray—the originator of the animated motion-picture drawing and the inventor of countless devices in connection with the screen—from whom it takes its name, "Brayco." To the science teacher this portable class-room projector possesses many advantages distinctively its own, in its ready adaptability to all conditions and its safety and simplicity of operation, thus offering the widest facilities for presenting such subjects as chemistry, physics, biology, nature study, or general science courses of all kinds. It is so simple in construction and operation that a child can learn to use it as readily as an adult. In connection with the laboratory, the machine will prove especially valuable, for it will magnify and project the minutest forms on a microscopic slide, thus enabling the entire class to discuss a subject at once, instead of necessitating the slow and laborious process of having each pupil examine it through the microscope in turn.

Special films, to meet special requirements of the individual instructor or class, can be made up on short notice, from photographs, drawings, X-ray or stereopticon slides at a nominal cost by the Brayco company. The Brayco weighs approximately 4½ pounds and is 10½ inches in height, or less than the ordinary desk telephone. It uses a small standard incandescent lamp, readily replaceable from any automobile or electrical supply store, and has a specially designed resistance cord, which eliminates the rheostat, and makes it possible to use the machine with any electric light connection.

The Status of Sex Education in the High Schools of the United States

FEW school principals or teachers of extended experience fail to realize the need among their pupils for some sort of instruction and guidance in matters pertaining to sex. Teachers, often better than parents, know that the natural curiosity of children regarding the structure and function of their bodies is frequently stimulated by crude facts imparted to them by ill-informed companions, and that unless this curiosity is satisfied in a clean way, children may develop an unwholesome attitude towards sex which they cannot share with their parents. with the advent of adolescence, the experienced teacher also knows, come body changes and a confusing desire to "try things out," which further stimulate sex curiosity and sometimes lead to experiments in direct sex relations or to semi-morbid dissatisfactions. As one pupil put it almost defiantly: "We are no babies. We have reached the menstruation period and shall know how children are reproduced. We know that there is something about the man and woman, but we do not know how and when." Teachers further know that ordinarily such curiosity quickly subsides when proper facts and counsel are given in a wholesome way.

It is undoubtedly a realization of this situation which has led to the many spontaneous attempts to introduce sex instruction into our high schools. Although there is at present no commonly accepted content or method of sex instruction to adolescents, there have sprung up all over the country experiments along this line, a few ineffective because engineered by the wrong type of teacher, but most of them so successful as to win approval of both school officials and the public. A questionnaire sent out in January, 1920, by the U. S. Bureau of Education and the U. S. Public Health Service to 12,025 A and B (accredited and partially accredited) high schools of the country brought 6,488 (53.8%) replies, and these returns indicated that 2,638 high schools, or 40.6% of those replying, are giving sex instruction of some sort. If the replies are representative, two-fifths of the A and B high schools of

the country are attempting sex education. If, however, it be objected that the replies are not representative because most of the schools not replying were unable to give a favorable answer, the statement is justified that at least one-fifth of the high schools of the country are striving to meet this need. Probably the actual situation lies somewhere between these two estimates. These figures are surprisingly large when one considers that content and method for sex instruction have not yet approached anything like standard form.

The returns from this questionnaire show that such instruction is not confined to one state or section; on the contrary, it has developed in every state, in cities and rural districts large and small, and in high schools of all sizes. The principal with a school of fifteen pupils seems to have sensed and acted upon the need as keenly as the head of a large city high school for boys. The proportion of schools giving this instruction is somewhat larger in the West than in other sections, although the actual number of high schools in the West is smaller than in either the Central States or the East. In Utah 21 schools reply in the affirmative and none in the negative; in Maine, one school answered yes to four answering no.

Following is a tabulation of replies:

1. Schools giving only emergency sex education, i. e., instruction through lectures, slides, sex hygiene exhibits and pamphlets...........	1633	
2. Schools giving sex education as a part of courses already in the curriculum.........	1005	
		2638
3. Schools giving no sex education		3850
Total		6488

The schools of group one have been giving instruction largely through talks by speakers from outside the school,—physicians, nurses, state health officers, Y. M. C. A. or Y. W. C. A. secretaries, social workers, ministers, superintendents or board members. Sometimes the principal himself gives these talks, sometimes one or more teachers. In number they range from one a year to one a week, in the latter case approximating regular hygiene instruction. Usually the sexes are segregated. Ac-

cording to the institution, the number attending such lectures varies from a small group to the whole school. The exhibit for boys ("Keeping Fit") developed by the U. S. Public Health Service, and loaned by the State Boards of Health, has been shown in many hundred schools to many thousand pupils. This exhibit has won marked approval and is in constant demand by high school principals. The U. S. pamphlet for boys, "Keeping Fit," is frequently used as supplementary material after a lecture or the showing of the exhibit.*

Returns from the second group, those schools giving sex instruction through courses in the curriculum, indicate that the following subjects are used as vehicles for sex education: the biological sciences (general biology, botany, zoology, general science, agriculture, animal husbandry and bacteriology), civics, the home-making courses (domestic science, home economics, household arts and home nursing), English, ethics, pedagogy, physical education, physiology-and-hygiene, psychology, and sociology. The biological sciences (for purposes of tabulation combined under one heading, because the instruction referring to sex is similar in all the courses having a biological content), provide over 50% of the instruction. Next in order come physiology-and-hygiene with 23% of the instruction, and the social sciences with 17%.

It is quite evident that in lieu of standards for content or method in sex instruction, experiments have been tried in many fields, another strong indication that teachers realize the need for this work. Rather than create new courses bearing on sex matters, there has been a wholesome realization that it is unwise to emphasize sex as a separate factor to the extent of making it a full course, but that, on the other hand, sex instruction and guidance should be imparted in a way that makes a pupil accept it as a normal part of life. Casual references to sex matters rob sex of much of its disturbing mystery for adolescents and give it a right setting.

The number of schools thus utilizing courses already in the curriculum as media for sex instruction varies greatly in the

* Since the questionnaire was sent out, a similar pamphlet for girls, "Healthy Happy Womanhood," and a girls' exhibit, "Youth and Life," have been issued, and are being widely and successfully used.

different states, ranging from 3.5% to 80.9% of the schools. The large percentage in some states is possibly influenced by the fact that the media are courses required by state syllabus, hence more widely given in the schools. Where, for example, biology is compulsory in the freshman year, the figures for that state are probably larger than where no such course is required.

It is obvious that the various topics related to sex are not equally appropriate to all courses, even among those used for sex instruction. The biological sciences seem to be most easily adaptable for dealing with the topic of human reproduction; they so commonly consider sex and reproduction in plants and lower animals that it is only a step to reproduction in man, which may be considered in the same objective and scientific way as in dealing with alga, fern, amoeba, frog, chick, or rabbit.

Sociology is much used for teaching a few simple facts about venereal diseases, ordinarily in connection with the study of society's defectives, or of the causes for divorce and the declining birth-rate. This is also a common vehicle for instruction about heredity and eugenics.

The physical education teacher, with regularly segregated groups, makes use of the excellent opportunity to talk frankly about the phenomena of menstruation, or, less frequently, of seminal emissions.

Physiology-and-hygiene is utilized for teaching facts about human reproduction, the venereal diseases, heredity and eugenics, internal secretions, control of sex instinct, menstruation and seminal emissions. The above order corresponds also to the order of frequency in which these topics are taught in all the courses combined.

In a majority of schools this sex instruction is given in the first two years of the school course. But this incidence seems to be due to the fact that the media used for such instruction happen to fall in these years rather than to a deliberate selection of the subjects as vehicles for instruction especially needed in early adolescence. For example, biology, botany, zoology and general science are usually freshman or sophomore subjects. Sociology, on the other hand, is distinctly a junior or senior subject, while hygiene and physical education may be taught in all four years, and the sex aspects of the instruction repeated each year.

Of the principals from group two answering the question about methods of presenting sex facts, more than one-half state that oral presentation is used, and one-third that supplementary readings are assigned. Individual conferences, general discussions and lectures are employed by one-fifth of the schools. Of special significance is the fact that 241 high schools indicate they have reached a point in sex instruction where class discussion can function as a normal part of the work.

Space was provided in the questionnaire for the opinions of principals regarding the introduction of sex instruction into courses of the curriculum. Three-fourths (4,887) of the principals replied. Eighty-five per cent of these favored such introduction, ten per cent were undecided, and only five per cent were opposed.

Eighty per cent of those principals who tried *emergency* sex instruction expressed themselves as favoring integrated instruction. They may have concluded that while in the "Keeping Fit" exhibit the facts of sex are properly subordinated, emergency lecturers are prone to emphasize the pathological, or that the isolation of sex facts in a single lecture or two, with sexes separated for the occasion, too strongly emphasizes the matter of sex and consequently the taboo ordinarily put upon it. Apparently their experience shows them the better possibilities of instruction integrated with appropriate courses.

There seems to be very general agreement among the principals as to the need of sex education. With few exceptions, differences of opinion are concerned with method to be used, rather than with need. The following replies are typical: "I regard it as being of fundamental importance." "The need is real and imminent." "Should be included in the curriculum of all high schools." "I think that the public ought to demand that it be included." "Need is great, as the ignorance of nature's laws exempts no human from paying the penalty in full." "I think the school that does not provide such instruction fails in its duty." "I deem it an essential in every respect; too many youths know practically nothing along this line."

Many principals state that the home has failed in its duty and that few parents realize their obligations and opportunities in this direction. For example: "There is a very emphatic

need for such instruction, since the parents are universally neglecting it." "I think the need is critical. These matters are usually left to home training, where natural reticence leads to neglect." An Ohio principal favors introducing such instruction into the school "because of failure of parents to acquaint the child with the facts, and because of the ease with which these facts can be linked with other subjects." "The students are exceedingly ignorant; they don't get such training at home." "Such courses are of real importance, as many children have no other opportunity to obtain such instruction."

In reply to the question as to whether the introduction of such topics into the curriculum had met with success, half the principals (1005) expressed an opinion. Eighty per cent of these replies indicate that such sex instruction has met with full success. Of the twenty per cent (103) stating that the instruction had failed to meet with the success they had hoped for, seventeen principals cited as the reason for failure community opposition, and an equal number considered their teachers not properly qualified for the work. Thirteen more mentioned parental objections, and seven indicated that their teachers were already overcrowded before the additional work was undertaken. Other difficulties include: "Work not systematically arranged." "Given too little." "Touches only a small portion of the school." "Pupils most needing the instruction do not elect the course." "Difficulty of scheduling segregated classes." "Lack of material." "Subject matter not sufficiently organized, complete, or accessible."

Throughout the great majority of these opinions runs the feeling that sex instruction is a most important task yet a difficult one for schools. Many principals deplore the lack of proper teachers for the work and feel that it should not be undertaken except by the right kind of instructor; in fact, several declare that without such a teacher the work does more harm than good. This indicates wholesome caution. To give sex instruction requires mental maturity, a personality that is always respected, poise, sanity, sympathy with adolescent boys and girls, an accurate knowledge of facts and the ability to present them impersonally, unimpeachable character, and great tact. Few teachers have these qualifications. Probably, however, there are some now not conducting this work who are

well equipped to do so, but are holding back until suitable methods are better developed.

Even though progress has been made in sex instruction in high schools and there are large numbers of principals favoring and undertaking it, it is well to continue to be cautious. Moreover, the figures herein given should not, perhaps, be interpreted too literally. The best of questionnaires are difficult of interpretation, and it is possible that some principals did not actually mean to imply such definite instruction was being given as their answers would indicate. The Bureau of Education and the Public Health Service are therefore following up the replies to these questionnaires in order to secure more exact information and further details about methods used. In this way the experience of schools succeeding in such pioneer and difficult work will be made available to others wishing to inaugurate new efforts in this direction and will furnish a sound basis for further developments in sex instruction.*

* It is expected that this additional material will shortly be ready for distribution to those who care to ask for it. Send to the U. S. Public Health Service, 16 Seventh Street S. W., Washington, D. C.

Does Dynamite Act Downward?

THREE things are firmly established in the mind of the average man with regard to dynamite, these being: (1) that it is powerful, (2) that it is dangerous, and (3) that its explosive energy is directed mainly downward.

There is no doubt about it being dangerous, particularly when it is poorly made or improperly handled, or when it is old and partially decomposed; but the idea that it acts mainly in a downward direction is altogether incorrect. Its force is not expended with special violence in any particular direction whatsoever. The popular belief to the contrary is based, without doubt, upon the fact that a charge of dynamite, when laid upon a rock and exploded without any tamping, will often rend the rock in two; whereas a heavy charge of gunpowder, when exploded under similar circumstances, has but little apparent effect.

This striking difference in behavior admits of an easy explanation from the standpoint of theory, and it has also been

investigated experimentally. General Abbot, for example, fired charges of dynamite under water, in the center of an upright iron ring carrying pressure-measuring devices at uniform intervals around its circumference, and found that the force of the explosion is substantially the same in all directions,—upward, downward and sidewise. The difference in behavior between dynamite and gunpowder, as far as this one feature is concerned, is apparent rather than real, and it depends upon the far greater quickness with which the dynamite explodes.

Gunpowder consists of carbon and sulphur, ground up very fine, and intimately mixed with some other substance (such as nitrate of potash) capable of yielding enough oxygen to burn both the carbon and the sulphur. The mixture is physical in its nature, and not chemical; and it is the exceedingly rapid burning of its individual particles that constitutes what we call the "explosion" of the powder.

Dynamite differs from powder in many respects, one of the most notable of the points of difference consisting in the fact that although powder can only be *burned,* dynamite can be either burned or *detonated.* The attendant phenomena are entirely different in the two cases, and so also are the chemical products that result from the decomposition. Dynamite burns rapidly when ignited by a flame, but it does not actually explode under these circumstances, so long as certain conditions are fulfilled. When, on the other hand, it is subjected to a certain kind of jar or shock, such as is produced by the explosion of a suitable fulminate cap, its molecules are shaken apart and the whole mass "detonates," or decomposes violently. This is the kind of action that is meant when we speak of the "explosion" of dynamite.

An explosion is never really *instantaneous.* It is an event that has a beginning and an end, and a finite (though very short) duration. We do not know the speed with which an explosive disturbance will traverse a mass of dynamite, but it has been found to pass through guncotton, under certain conditions, at the rate of about 17,000 feet per second. The time required for the completion of an explosion is very much shorter in dynamite than it is in gunpowder; for in the powder the grains must burn from their surfaces to their centers, whereas in the dynamite the molecules merely have to rearrange

themselves internally. It is impossible to give exact figures for the duration of a powder explosion or a dynamite explosion, but for present purposes we may assume that the duration is 1/100 second for the powder, and 1/1000 second for the dynamite. We do not give these figures as actual estimates in either case. They are intended to be merely illustrative and suggestive, in connection with the explanation we are about to give of the difference in the actions of black powder and dynamite, when exploded in the open air.

When either dynamite or powder explodes, a large quantity of gas is generated with extreme rapidity, and the gas so produced at once begins to rush away from the explosive center in all directions, unless it is confined in some manner. Now, although the gas is very light and mobile, it nevertheless has a certain amount of inertia, and a finite (though very short) time must therefore elapse before it can acquire any considerable velocity, even though it is urged by a great force. In the meanwhile it is limited to a small space by reason of the fact that it has not had time to escape, and hence it is under a great compression, and it exerts a corresponding pressure against any solid body with which it may be in contact. If the charges of powder and dynamite that are used in the experiment are selected so that they will generate the same volumes of gas (when these volumes are measured under identical conditions of temprature and pressure), then the dynamite will produce a far greater momentary pressure than the powder, because its gas is liberated far more quickly, and has a correspondingly smaller time to make its escape from the region in which it is generated. There would therefore be a marked difference in the effects, even if the two charges were exploded in a vacuum; and when they are blanketed by the atmosphere, as they are in all ordinary cases, the difference may be much more pronounced, because the air impedes the escape of gases and alters the nature of the action correspondingly.

In the actual case the gases from the dynamite, at the instant that the explosion terminates, may be confined within a space that is only a thousandth part as great as the space which is occupied by the gases from the powder at the exact termination of the powder explosion; and this means that the pressure

exerted momentarily by the dynamite may be a thousand times as intense as the pressure exerted momentarily by the powder. Hence the dynamite may be expected to produce a prodigiously greater effect against the rock; and this is the real explanation of its apparent "downward" tendency.

If the dynamite is laid against the *side* of the rock, as in the blasting operation known as "mudcapping," or if it is placed closely against the lower face of an overhanging or shelving rock, the same difference in effect between the dynamite and the powder is observed; but these are less familiar cases, and hence they have had little or no effect in molding public opinion.

It should be understood that we do not pretend that numerical data given in this article are at all accurate (except as regards the speed of propagation of an explosion through guncotton). We have assumed them, and used them, merely to illustrate the principle that is involved. The calculation of the real pressure produced against a rock by an explosion in the open air would be difficult, or altogether impossible; and it would certainly involve many considerations that have here been omitted. —*Travelers Standard.*

Elihu Thomson Awarded the Kelvin Medal

Elihu Thomson, noted scientist, of Swampscott, Mass., and consulting expert of the General Electric Company, is the first American to be honored with the gold medal known as the Kelvin Medal. The Kelvin Medal has been awarded to but one other man. That was three years ago, to Raymond Unwin, England's foremost garden city planner. The medal is awarded for eminence in engineering and in the work which Lord Kelvin himself was most interested in, general science and engineering.

Fiddling Down Bridges

EVERY little while there is an item in the public press about the effect of vibration on engineering structures, and the old story is revived of somebody who wrecked a bridge by finding out its natural period of vibration and playing the corresponding note on his fiddle, near by. The idea is that the action is cumulative, and that the vibration of the bridge becomes greater as time goes on, until destruction finally results.

Buildings can no doubt be jarred to pieces, by earthquakes or other powerful agencies, and the vibration of a steamship having a natural period nearly equal to that of the engines is sometimes quite severe, though it is unlikely that ships have ever been destroyed in this way. But the fiddle as an implement of destruction is quite out of the question, for many reasons. Most important among these is he fact that the total amount of energy absorbed from the fiddle by the vibrating bridge can never exceed the amount of energy that is given out by the fiddle itself; and this, in turn, can never exceed the amount of the mechanical work done by the musician in playing the bow. Moreover, the sound-energy is radiated into the air in all directions, and only the trifling fraction of it that strikes the bridge could possibly be effective.

It is entirely outside of the province of engineering to comment in any way upon the twentieth verse of the sixth chapter of Joshua. —*Travelers Standard.*

Color-Blindness

As long as colored signals continue to be used in railroad work, it will be important for the men who have to observe and interpret these signals to be carefully examined for color-blindness. It is not generally known that partial color-blindness, or other serious disturbances of the sense of color, may arise as a result of using alcohol or tobacco, and also as a consequence of sickness or injury. These facts do not appear to be fully understood, even by physicians; and men who have passed the color test usually feel that there can be no subsequent uncertainty about their ability to distinguish color, at least for a con-

siderable time. Color-blind persons are usually defective from birth; but hysterics, neurasthenia, and cerebral congestion may produce temporary defects in the power of distinguishing colors, and either temporary or permanent effects may be produced by alcohol or tobacco and by injuries of certain kinds, as already stated. This shows that men who have to watch for colored signals owe it to themselves and to the public to have their eyes examined after severe injuries and illnesses, and to abstain from alcohol and tobacco, at least to the point of avoiding excess. Excess to one man may not be so to another, however, and a person addicted to any habit is seldom ready to believe that his own indulgence is excessive. Each man should bear this fact in mind, however, and should apply it to himself as conscientiously as he can. —*Travelers Standard.*

The New Books

The New Agriculture—Henry J. Walters—549 pages—357 illustrations—$1.60—Ginn and Company.

This book aims to give the pupil the essential knowledge for starting farm work scientifically, as well as to give him a clear view of what farming means, in order to help him choose between it and some other occupation. It is well illustrated and interestingly written. Boys having any inclination toward agriculture will eagerly read it. After a chapter on "The Farmer and his Task," the different crops, farm animals and soils are covered in detail It is a high school book.

Climatic Laws—S. Visher—96 pages—7 figures—Price $1.50—John Wiley & Sons, Inc.

As the title indicates, this is a book of laws relating to climate. Ninety laws, which were first circulated as preliminary statements to many authorities for criticism, are now concisely worded and discussed. This is practically the only work in which these laws have been brought together. The book will therefore appeal to all who have an interest in climatic generalizations.

Powers General Chemistry Test—S. R. Powers—$1.35 per package of twenty-five—World Book Company.

The standard package contains manual of directions, key for scoring and class record, and twenty-five copies of the test. The tests are prepared in two forms: A and B. The test is an accomplishment test of pupils in high school chemistry. There are two parts: Part 1 gives thirty items of information, Part 2 gives thirty-seven items on formulas, equations, chemical names, and calculations.

Ruch-Cossman Biology Test—Ruch and Cossman—$1.50 per package of twenty-five—World Book Company.

The standard package contains manual of directions, key for scoring and class record, with twenty-five tests. There are two forms of tests, A and B, of equal difficulty. Each form is in five parts: 1. Select best word in seven given for answer; 2. Select best of three sentence answer; 3. Name numbered parts of drawing; 4. On mendalian inheritance; 5. Missing word paragraphs.

Plant Anatomy—Revised edition—W. C. Stevens—398 pages—155 illustrations—$3.50—P. Blakiston's Son & Co.

Plant anatomy shows the evolution of different physiological tissue systems, how these systems are adapted to carry out the plant's functions, how they gain their living from unorganic matter, and how they overcome obstacles in the environment.

The subject matter by chapters is: The Plant Cell, Tissues, Protection from Injuries and Loss of Water, The Plant Skeleton, Absorbtion of Water and Minerals, Transport of Water and Soil Solutes, Intake and Distribution of Gases, Construction of the Plant's Food, Transport of Food throughout the Plant, Storage of Food and Water, Secretion and Excretion, Reproduction, The Preparation of Sections, Use of the Microscope, Reagents and Processes, Micro-Chemistry of Plant Products, Detection of adulterations of Foods and Drugs

High School Chemistry—S. R. Powers—84 pages—Teachers College Publication Office, N. Y. C.

This is a report upon a study to determine whether the hypothesis that "the task set for accomplishment by the high school students of chemistry is too large, and that the materials of instruction are but poorly mastered by those who study it," is true or false. The various tests applied are given with the results. The conclusions drawn indicate clearly the need of further study of the high school chemistry problem, with a view to drastic revision. Every chemistry teacher ought to read, yes, study the findings of this thorough and painstaking piece of work.

An Elementary Study of Chemistry—McPherson and Henderson—628 pages—250 illustrations—$2.40—Ginn & Co.

This third edition of this popular college text brings it into line with the best thought and requirements of this exacting science. It is up-to-date in matters of recent knowledge. Its object is to train pupils "to grasp the fundamental facts and theories of the science and to reason correctly in chemical relations." It is somewhat more elementary than "A Course in General Chemistry" by the same authors.

Physics—Oscar M. Stewart—723 pages—466 illustrations—$3.60—Ginn & Co.

This text treats mechanics, heat, sound, magnetism, electricity, and light very thoroughly, and yet in a way rather more suitable to the general college student than for the one who is specializing in engineering. Modern theories are interestingly discussed; observed facts are considered before generalizations are made. There are many applications of the principles to daily life. Problems for solution are given at the ends of the chapters. Altogether it is an exceptionally fine book for college use.

Laboratory Problems in Physics—Cavanagh and Westcott—127 pages—illustrated—96 cents—Ginn and Company.

This is a manual of fifty-nine experiments in high school physics Thirty of them are starred to indicate a minimum course. Titles of the first five experiments will indicate the type of course. 1. Determine the area of a triangle. 2. Determination of volume and density. 3. Graph method of representing relations. 4. A study of buoyancy or supporting force by a liquid. 5. The specific gravity of salt solution by several methods. A very valuable feature of this book is that of giving a preliminary discussion on the subject matter of the experiment. In many cases problems for solution are added at the close of the experiment.

Junior High School Life—Thomas—Tindal and Myers—287 pages—Illustrated—The Macmillan Company.

This account of the Holmes Junior High School in action will be welcomed by all who are interested in the development of junior high schools. Some of the chapter titles are, Democracy and Education, Physical and Curricular Guidance, Scholastic Reënforcements, Social, Vocational and Civic Guidance, Students Participation in School Government, Avocational and Ethical Guidance, Grade Forums, School Clubs, Intracurricular Activities. The suggestions given in this book will be of inestimable value to those interested in this field.

Junior High School Mathematics—Vosburg, Gentleman and Hasslar—228 pages—78 figures—The Macmillan Company.

A fine seventh grade book in mathematics. Interest is added by the few historical sketches of early development in the use of numbers. There is much excellent drill material, and a chapter "Percentage Applied to Problems of Business," is particularly unique and valuable.

First Lessons in Geography—P. A. Knowlton—257 pages—numerous halftones, maps, and color illustrations—The Macmillan Company.

This book offers a new and most promising attempt to solve the problem of preparing a basis for later geography. Its simplicity of terms and its building upon the experiences of children are strong points of the book. It aims to interpret only the most significant features of the environment to the child. It covers the fundamental needs of food, clothing, shelter, tools and transportation. To read the book is to like it.

Animal Husbandry for Schools—Revised edition—M. W. Harper—615 pages—241 illustrations—The Macmillan Company.

This book is an introduction to animal husbandry for high school students or for a short course in college. The book carries a practical viewpoint throughout Laboratory exercises and home projects are suggested. In content the books covers horses, dairy cattle, beef cattle, sheep, swine, and poultry. There is besides much valuable information in the appendices.

College Manual of Optics—Lloyd W. Taylor—236 pages—105 cuts—$2.80—Ginn and Company.

The neglected field of optics should receive stimulation from this book, which brings this study up to date with modern research. This manual not only covers laboratory work, but it serves as a classroom text as well.

Problems in General Physics—Morton Masius—154 pages—75 illustrations—$2.00—P. Blakinston's Son and Company.

This book contains 1008 problems covering the entire field of general physics. It is adapted to accompany the latest edition of Duff's "Textbook of Physics," but should be of interest to those using other texts in college courses as well.

Inorganic Physical Chemistry—G. H. Cartledge—463 pages—56 diagrams—$4.80—Ginn and Company.

Biology and medicine depend upon physical chemistry, whose importance is revealed more and more as time goes on. This book is organized to present physical chemistry as an essential tool to students who plan to go further in scientific or medical study. The general divisions of the book are: (1) The nature of matter; (2) the nature of solutions; (3) the nature of reaction; (4) applications. There are fifty-one valuable tables included in the work and each chapter ends with a set of problems.

Everyday Biology—J. A. Thomson—262 pages—$1.25—G. H. Doran Company.

Every general science teacher wishes to build up a library of supplementary reading matter for the general science pupils. Everyday Biology is the type of book that is needed in many fields of science for the general science library. A few of the chapter titles of this book are: The Emergence of Life, The Unread Riddle of Life, The Engines of the Body, Food Getting and Food Using, How Many Senses Are There? Hot and Cold, Cocks and Hens, The Living Past and Heredity, Infection and Disease, The Length of Life's Tether. Written in effective, popular style, this book will not only entertain you but afterwards you feel that you have gained something of value from its reading.

Soils and Crops—John H. Gehrs—444 pages—221 illustrations—The Macmillan Company.

This book, with its accompanying "Live Stocks and Farm Magazine," by the same author, furnishes the essential material in agriculture for elementary schools. The book is entertainingly written, attractively illustrated, and covers a wide range of agricultural topics. The suggestions having laboratory work and home projects, found at each chapter end, are valuable features of the book.

The Object and Organization of Science Service

To bridge the gap between modern science and the public by disseminating scientific information in popular form, Science Service has been established at Washington. It is chartered as a non-profit-making corporation and all receipts from the sale of articles, books or films will be devoted to the development of new methods of popular education in science. The governing board of fifteen truestees consists of ten scientists and five journalists.

Through the generosity of Mr. E. W. Scripps, Science Service has been assured of such financial support as to insure its independence. It is not under the control of any clique, class or commercial interest. It is not the organ of any one association. It serves all the sciences. It does not indulge in propaganda, unless it be propaganda to urge the value of research and the usefulness of science.

Science Articles in Current Periodicals

AERONAUTICS

The non-stop flight across America. Ill. John A. Macready. Nat. Geog. Mag. 46:1-83. July 1924.

Man's amazing progress in conquering the air. Ill. J. R. Hildebrand. Nat. Geog. Mag. 46:93-122. July, 1924.

Racing the sun from sea to sea. Ill. Lit. Dig. 82:1:15. July 5, 1924.

Night mail makes new era in aviation. Pop. Mech. 42:267. Aug. 1924.

World's greatest adventure a triumph for the airship. Ill. Wm. N. Hensley. Pop. Sci. Mo. 105:4:33. Oct. 1924.

The trans-Atlantic voyage of ZR-III. Sci. Am. 131-115. Aug. 1924.

ARC LAMPS

Early arc lamps. Ill. C. J. Fitch. Prac. Elec. 3:510. July, 1924.

ASTRONOMY

The world's greatest spectacle. Ill. R. J. Brown. Pop. Sci. Mo. 105:1:27-29. July, 1924.

Could we decode Mars' messages. Fitzhugh Green. Pop. Sci. Mo. 105:2:27. Aug. 1924.

New wonders in giant twin star. Ill. J. S. Plaskett. Pop. Sci. Mo. 105:4:49. Oct. 1924.

The old and new in astronomy. Ill. Charles T. Dahama. Sci. and Inven. 12:258. July, 1924.

ATOMS

Putting the atom to work. Sir Oliver Lodge. Sci. Am. 130:306. May, 1924.

AVALANCHES

Avalanches. Andre Allix. Ill. Geog. Rev. 14:519-560. Oct. 1924.

BUTTER

The story of butter and butter making. George L. McKay. Am. Food Jour. 19:173. Apr. 1924.

CADIZ

Adventurous sons of Cadiz. Ill. 16 pages in color. Harriet C. Adams. Nat. Geog. Mag. 46:153-204. Aug. 1924.

CHINA

Loess and rock dwelling of Shensi, China. Fuller and Clapp. Geog. Rev. 14:215. Apr. 1924.

CITY PLANNING

An exceptionally planned rural community. Ill. Lee Shippey. Amer. City. 31:232. Sept. 1924.

EARTH

Inside the earth and out. Sir Oliver Lodge. Sci. Am. 130:374. June, 1924.

EDUCATIONAL

Laboratory methods of introductory science. P. E. Rowell. Jour. Ed. Methods. 3:98. Nov. 1923.

Supervising study in natural science. C. J. Piper. School Review. 32:122. Feb. 1924.

EXPLOSIVES
Liquid oxygen lifts 4,500 tons of rock. Ill. Lit. Dig. 82:1:25. July 5, 1924.

EYE
Illuminating and its effect on the human eye. Charles Sheard. Nation's health. 6:316. May, 1924.
The importance of routine eye examinations. Nation's Health. 6:321. May, 1924.

FLOWERS
Where orchids are at home. Ill. E. H. Wilson. Gar. Mag. 39:315. May, 1924.

FOODS
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Cyanogen chloride fumigation. Ill. W. C. Rucker. Nation's Health. 6:387. June, 1924.

GARBAGE
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GRAND CANYON
Surveying the Grand Canyon of Colorado. Ill. L. R. Freeman. Nat. Geog. Mag. 45:471-548. May, 1924.
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A health story for children. Ruth Strang. Jour. Home Econ. 16:303. June, 1924.
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How to educate communities in use of milk. Child Health Mag. 5:203. May, 1924.
Relation of animal diseases to public health. J. A. Beard. Nation's Health. 6:469. July, 1924.
Ship's standard medicine chest. Nat. Health: 6:546. Aug. 1924.
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The war on ants. Ill. S. F. Aaron. Sci. Amer. 131:106. Aug. 1924.

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Nature's super-power plant. Ill. G. M. Dyle. Pop. Sci. Mon. 105:2:24. Aug. 1924.
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Response of plants to artificial light. Hugh Findlay. Trans. Ill. Eng. Soc. 19:318. Apr. 1924.
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Do you sleep too much? D. A. Laird. Pop. Sci. Mo. 105:4-43. Oct. 1924.

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The story of steel. Sci. Amer. 130:310 and 396. May and June. 131:98. Aug. 1924.

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Making swimming safe for the people. W. B. McNamee. Amer. City. 31:11. July, 1924.

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Early history of the telephone. Ill. Prac. Elec. 3:562. Aug. 1924.

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Whole world taking up the motor bus. M. E. Forbes. Com. Amer. 21:29. Aug. 1924.

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A new tree garden for the Middle West. Ill. A. G. Eldredge. Garden Mag. 39:219. May, 1924.

TUNNELS

Lighting for the Hudson River Vehicular Tunnel.

VOLCANOES

Volcanoes—cosmic shell-holes. Ill. D. M. Barringer. Sci. Amer. 131:10 and 102. July and Aug. 1924.

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Hard water and water softening. E. F. Badger. Amer. City. 31:33. July, 1924.

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Water supplies of the Panama Canal. Ill. George C. Bunker. Nation's Health. 6:381. June, 1924.

WEATHER

Long-range weather forecasting. Ill. H. J. Browne. Sci. Amer. 131:82. Aug. 1924.

World weather—a review. Sir Napier Shaw. Geog. Rev. 14:416. July, 1924.

Magazine List

American City. 443 Fourth Ave., N. Y. C. Monthly. $4.00 a year, 50c a copy. The science problems of city and rural communities are treated in numerous articles, well illustrated. A valuable student and teacher reference.

The American Food Journal. 25 E. 26th St., New York City. Monthly. $3.00 a year, 25c a copy. Articles on food manufacture, food legislation, and experiments in nutrition.

Commercial America. Phila. Com'l Museum, Phila., Pa. $2.00 a year. Ill. Commercial production. New inventions. Will interest commercial geography and science teachers.

Current Opinion. 65 W. 36th St., N. Y.,Monthly. 35c a copy, $4.00 a year. Has a regular department "Science and Discovery," containing articles of popular interest, adapted to pupils or teachers.

The Educational Screen. 5200 Harper Avenue, Chicago. Monthly. 15c a copy, $1.00 a year. Discusses the use of movies in our schools; gives brief descriptions of educational films and lists theatrical films which are suitable for children. The journal is entirely educational, having no commercial affiliations.

Garden Magazine. Garden City, N. Y. Monthly. 25c a copy, $3.00 a year. Ill. Helpful to amateur gardeners, teachers and pupils.

General Science Quarterly. Salem, Mass. Quarterly. 40c a copy, $1.50 a year. The only journal published devoted alone to science in the elementary and secondary schools. It tells what schools are doing in science, gives lesson plans, demonstrations, and an extensive bibliography of usable articles in current periodicals.

The Geographical Review. Broadway at 156th St., N. Y. Quarterly. $1.25 a copy, $5.00 a year. Devoted to scientific geography. Original maps and pictures. One department contains condensed items of topics of current interest.

The Guide to Nature. Sound Beach, Conn. Monthly. 15c a copy, $1.50 a year. Ill. Of interest to elementary pupils and teachers of nature study.

Hygeia. 535 No. Dearborn St., Chicago. Monthly. 25c a copy, $3.00 a year. Popular articles on individual and community health. A valuable supplement to classroom work in hygiene.

Industrial and Engineering Chemistry. Box 505, Washington, D. C. Monthly. 75c a copy, $7.50 a year. A technical journal which contains much material which teachers can use.

Industrial Education Magazine. Peoria, Illinois. Monthly. $1.50 a year, 25c a copy. An illustrated magazine, which is indispensable to the shop instructor and to others who would "keep up" in industrial education.

Journal of Chemical Education. Easton, Pa. Monthly. $2.00 a year. Promotes chemical education; primarily a journal for the chemistry teacher. Digests of activities of chemical associations.

Journal of the Franklin Institute. Philadelphia, Pa. Monthly. 50c a copy, $6.00 a year. Ill. A technical journal. Contains many articles of value to science teachers.

Journal of Home Economics. 1121 Cathedral St., Baltimore. Monthly. 25c a copy, $2.50 a year. For teachers.

The Literary Digest. 354 Fourth Ave., N. Y. Weekly. 10c a copy, $4.00 a year. Has a department "Science and Invention." Articles are mostly digests from other journals. They are popular in nature and suitable for high school pupils.

National Geographic Magazine. Washington, D. C. Monthly. 50c a copy, $3.50 a year. Best monthly journal for high grade pictures. Articles are of interest to general reader, pupils and teachers, as well as to geographers.

The Nation's Health. 22 E. Ontario St., Chicago, Ill. Monthly. $3.00 a year, 25c a copy. An illustrated magazine devoted to community, industrial and institutional health problems. Very helpful to the science and hygiene teacher.

Nature Magazine. 1214 16th Street, Washington, D. C. Monthly, 25c a copy, $2.00 a year. A nature magazine, with popular articles exceptionally well illustrated. Includes what was formely "Nature Study Review."

Popular Mechanics Magazine. Chicago. Monthly. 25c a copy, $3.00 a year. Short science items and articles well illustrated. Appeals strongly to elementary pupils. Suggests many construction projects.

Popular Science Monthly. 255 W. 39th St., N. Y. C. Monthly. $2.50 a year, 25c a copy. A review in text and pictures of the news of science and invention, presented in a humanistic and inspirational way. Used as a supplement to text-books in many high schools. Valuable to science pupils and teachers.

Monthly Guide for Science Teachers. Issued by "Popular Science Monthly," October to June. 25c a year. A valuable teacher's aid, giving lesson plans, experiments, and many reference suggestions for secondary science teachers.

Practical Electrics. New York City. Monthly. 20c a copy, $2.00 a year. This is especially suggestive to boys who are making things electrical. There are numerous articles on electrical topics.

Radio News. 53 Park Place, New York City. 25c a copy, $2.50 per year. Monthly. A practical periodical for all who are interested in radio. Gives radio progress, new hook-ups, and gives much help to one who may wish to construct his own set.

Review of Reviews. 30 Irving Place, New York City. Monthly. 35c a copy, $4.00 a year. An illustrated monthly covering world affairs. Contains many good articles bearing on science, suitable for class reports.

Safety Engineering. 80 Maiden Lane, New York. Monthly. $3.00 a year. 25c a copy. A journal devoted to conservation of life and property and contains much material helpful in science classes.

School Science and Mathematics. Chicago. Monthly. $2.50 a year. A teacher's journal. Includes many helpful suggestions.

Scientific American. Woolworth Building, N. Y. Monthly. 35c a copy, $4.00 a year. Has longer articles than the other popular science journals. Illustrated, and is particularly valuable to high school science pupils and teachers.

Science and Invention. 53 Park Place, N. Y. C. Monthly. 25c per copy, $2.50 a year. Ill. Popular articles on astronomy, physics, photography, radio-activity, medicine, and, in fact, science in general.

Scientific Monthly. Garrison, N. Y. 50c a copy, $5.00 a year. Articles as a rule are more along lines of pure science. Much of value to teachers. Articles can be read to advantage by many pupils.

Science News-Letter. Science Service, 1115 Connecticut Ave., Washington, D. C. Weekly. 10c a copy, $5.00 a year. Gives a valuable current summary of the progress of science, in a form usable in science classes.

Transactions of the Illuminating Engineering Society. 29 West 39th St., N. Y. Monthly. $1.00 a copy, $7.50 a year. Technical. Many articles contain material which can be used in high school classes.